# PATENT ABSTRACTS OF JAPAN

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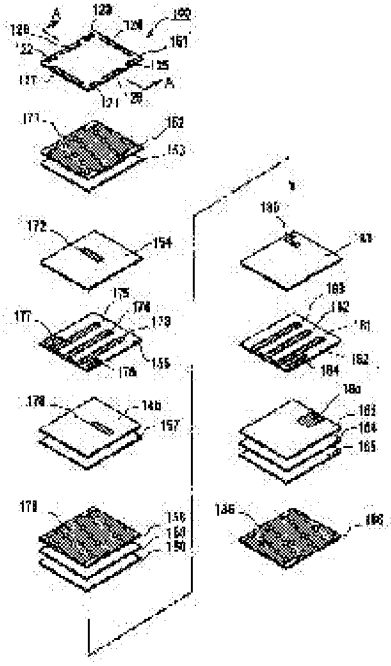
(21)Application number : 2001-065490 (71)Applicant : TAIYO YUDEN CO LTD

(22)Date of filing : 08.03.2001 (72)Inventor : INOUE MAKOTO

(54) **LAMINATED DUPLEXER ELEMENT**



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a laminated duplexer element in which the best frequency characteristics can be set for each filter circuit.

SOLUTION: This laminated duplexer element is provided with a filter circuit for reception and a filter circuit for transmission. The filter circuit for reception has grounding conductors 171 and 179 provided to hold a plurality of conductor pieces 172, 176, 177, and 178 containing resonance lines 173, 174, and 175 between them through dielectric layers 152-157 and pass signals in a first frequency band. The filter circuit for transmission has grounding conductors 179 and 186 provided to hold a plurality of conductor pieces 180 and 185 containing resonance lines 181, 182, and 183 between them through dielectric layers 158-165 and pass signals in a second frequency band, which is different from the first frequency band. One or more of the conductor pieces and grounding conductors of the filter circuit for reception are provided on layers, which are different from those on which the conductor pieces and grounding conductors of the filter circuit for transmission are provided.

## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the lamination duplexer element used for a car telephone, a portable telephone set, etc.
[0002]
[Description of the Prior Art]Conventionally, in a portable telephone set, in order to communicate by making each of the frequency of two different frequency bands using one antenna the object for transmission, and reception, a duplexer may be used.
[0003]This kind of duplexer is provided with two filter circuits which pass the signal of a mutually different frequency band, it is set as setting out so that one filter circuit may pass the signal of the frequency band for reception, and it is set up so that the filter circuit of another side may pass the signal of the frequency band for transmission. The dielectric resonator of a coaxial type which is indicated by JP,5-267909,A, for example was used for the filter circuit.
[0004]However, with the miniaturization of electronic equipment in recent years, the necessity for a miniaturization produced a portable telephone set and the electronic parts which a miniaturization and a weight saving are desired and constitute an electronic circuit, and the limit was shown in attaining a miniaturization with the duplexer using a coaxial-type dielectric resonator which was mentioned above.
[0005]In order to attain the further miniaturization of a duplexer, the duplexer of the lamination type which constituted the filter circuit by pieces of a conductor, such as a stripline, was proposed (JP,6-85506,A, JP,11-122007,A).
[0006]
[Problem(s) to be Solved by the Invention]However, it was difficult to be easy to receive

the electrical influence between two filter circuits, and the electrical influence from the external world, and to obtain the good characteristic in both filter circuits in the duplexer of the lamination type of the conventional example mentioned above. When the construction material of each insulation layer and the distance of thickness and a resonant-line way, and a ground conductor were set up so that the characteristic of one filter circuit may be in a good state, the best characteristic might not be obtained as the characteristic of the filter circuit of another side.

[0007]The purpose of this invention is to provide the lamination duplexer element which can set up the best frequency characteristic in each filter circuit in view of the above-mentioned problem.

[0008]

[Means for Solving the Problem]This invention in order to attain the above-mentioned purpose in claim 1. The 1st filter circuit that has two or more pieces of a conductor including a resonant-line way, and passes a signal in the 1st frequency band, A lamination element assembly including the 2nd filter circuit that passes a signal in the 2nd frequency band that has two or more pieces of a conductor including a resonant-line way, and is different from said 1st frequency band, The 1st input/output terminal that was formed in an outside surface of said lamination element assembly, and was connected to one input output end of said 1st filter circuit, The 2nd input/output terminal that was formed in an outside surface of said lamination element assembly, and was connected to one input output end of said 2nd filter circuit, A common input/output terminal which was formed in an outside surface of said lamination element assembly, and was connected to an input output end of another side of said 1st filter circuit, and an input output end of another side of said 2nd filter circuit, In a lamination duplexer element provided with an earthing terminal formed in an outside surface of said lamination element assembly, Form two or more ground conductors arranged so that a piece of a conductor including a resonant-line way of said 1st filter circuit and a piece of a conductor including a resonant-line way of said 2nd filter circuit may be individually inserted via an insulation layer for every filter, and one or more of a piece of a conductor of said 1st filter circuit and ground conductors. A lamination duplexer element provided in a different layer from a layer in which a piece of a conductor and a ground conductor of said 2nd filter circuit are formed is proposed.

[0009]Since a piece of a conductor including a resonant-line way of said 1st filter circuit is inserted by a ground conductor via an insulation layer according to this lamination duplexer element, said 1st filter circuit is covered from the external world and said 2nd filter circuit by this ground conductor. Since a piece of a conductor including a

resonant-line way of said 2nd filter circuit is inserted by a ground conductor via an insulation layer, said 2nd filter circuit is covered from the external world and said 1st filter circuit by this ground conductor. When one or more of a piece of a conductor of said 1st filter circuit and ground conductors provide in a different layer from a layer in which a piece of a conductor and a ground conductor of said 2nd filter circuit are formed, Thickness of each insulation layer and distance of a resonant-line way and a ground conductor can be set up so that the best characteristic can be obtained for every filter.

[0010]In claim 2, distance between two ground conductors which face across a resonant-line way of said 1st filter circuit proposes a lamination duplexer element set as a different value from distance between two ground conductors which face across a resonant-line way of said 2nd filter circuit in the lamination duplexer element according to claim 1.

[0011]According to this lamination duplexer element, in each of said 1st filter circuit and the 2nd filter circuit, it is set as a value from which distance between two ground conductors which face across a resonant-line way differs, and the impedance characteristic of a band pass of each filter circuit is set up.

[0012]In the lamination duplexer element according to claim 1 or 2 at claim 3, In [ a resonant-line way and said 1st input/output terminal of between a resonant-line way of said 1st filter circuit, and said 2nd input/output terminal, or said 2nd filter circuit / between ] either at least, A lamination duplexer element which formed a ground conductor connected to said earthing terminal so that said input/output terminal might be surrounded in one or more layers.

[0013]If according to this lamination duplexer element a ground conductor connected to said earthing terminal is formed so that said 2nd input/output terminal may be surrounded between a resonant-line way of said 1st filter circuit, and said 2nd input/output terminal, An electric combination between a resonant-line way of said 1st filter circuit and said 2nd input/output terminal is controlled. If a ground conductor connected to said earthing terminal is formed so that said 1st input/output terminal may be surrounded between a resonant-line way of said 2nd filter circuit, and said 1st input/output terminal, an electric combination between a resonant-line way of said 2nd filter circuit and said 1st input/output terminal will be controlled. Thereby, you can set up the characteristic of each filter circuit individually, and can make it stabilized.

[0014]In claim 4, a lamination duplexer element which arranges in piles a portion in which said 1st filter circuit was formed, and a portion in which said 2nd filter circuit was formed to a laminating direction is proposed in the lamination duplexer element according to any one of claims 1 to 3.

[0015]Since a portion of said 1st filter circuit and a portion of the 2nd filter circuit are arranged in piles in a laminating direction according to this lamination duplexer element, packaging areas are reduced and high density assembly becomes possible.

[0016]In claim 5, said lamination element assembly proposes a lamination duplexer element which puts in order a portion in which said 1st filter circuit is formed, and a portion in which said 2nd filter circuit is formed in the direction to which a layer extends, and arranges them in the lamination duplexer element according to any one of claims 1 to 3.

[0017]Since according to this lamination duplexer element a portion of said 1st filter circuit and a portion of the 2nd filter circuit arrange in the direction to which a layer extends and are arranged, height of a lamination duplexer element can be set up low and it becomes applicable to thin electronic equipment.

[0018]In claim 6, said lamination element assembly proposes a lamination duplexer element with which a part of portion in which said 2nd filter circuit is formed comes to laminate a part of portion in which said 1st filter circuit is formed in the lamination duplexer element according to any one of claims 1 to 3.

[0019]Since according to this lamination duplexer element it laminates so that a part of portion in which said 1st filter circuit is formed may lap with a part of portion in which said 2nd filter circuit is formed, electric interference between each filter circuit is controlled, and packaging areas can be reduced.

[0020]In the lamination duplexer element according to claim 4 at claim 7, Said resonant-line way consists of a piece of a beltlike conductor by which one end was connected to said earthing terminal, and the other end was opened wide, and proposes a lamination duplexer element arranged so that a resonant-line way of said 1st filter circuit may cross right-angled via an insulation layer to a resonant-line way of said 2nd filter circuit.

[0021]Since according to this lamination duplexer element it is arranged so that a resonant-line way of a resonant-line way of said 1st filter circuit and said 2nd filter circuit may cross right-angled mutually via an insulation layer, an input/output terminal of each filter circuit can be easily arranged on an outside surface on which lamination element assemblies differ.

[0022]In claim 8, in the lamination duplexer element according to claim 4, said resonant-line way consists of a piece of a beltlike conductor by which one end was connected to said earthing terminal, and the other end was opened wide, and. Each resonant-line way is arranged so that one end of a resonant-line way of said 1st filter circuit may be located in the other end side of a resonant-line way of said 2nd filter

circuit and the other end of a resonant-line way of said 1st filter circuit may be located in the one end side of a resonant-line way of said 2nd filter circuit, As a ground conductor formed so that said piece of a conductor might be inserted via an insulation layer, It is arranged between a resonant-line way of said 1st filter circuit, and a resonant-line way of said 2nd filter circuit, It has the 1st and 2nd ground conductors formed in a mutually different layer, Said 1st ground conductor is formed in one half by the side of an open end part of a resonant-line way of said 1st filter circuit of fields, and said 2nd ground conductor is formed in one half by the side of an open end part of a resonant-line way of said 2nd filter circuit of fields, Distance between a resonant-line way of said 1st filter circuit and said 1st ground conductor is set up smaller than distance between a resonant-line way of said 2nd filter circuit, and said 1st ground conductor, and distance between a resonant-line way of said 2nd filter circuit and said 2nd ground conductor, A lamination duplexer element set up smaller than distance between a resonant-line way of said 1st filter circuit and said 2nd ground conductor is proposed.

[0023]According to this lamination duplexer element, capacitance occurs between said 1st ground conductor and an open end part of a resonant-line way of said 1st filter circuit, Compared with a time of said capacitance not being found in the same resonance frequency, the length of a resonant-line way of said 1st filter circuit can be shortened, and Q of the 1st filter circuit can be raised. Similarly capacitance occurs between said 2nd ground conductor and an open end part of a resonant-line way of said 2nd filter circuit, Compared with a time of said capacitance not being found in the same resonance frequency, the length of a resonant-line way of said 2nd filter circuit can be shortened, and Q of the 2nd filter circuit can be raised. Since the number of laminations of an insulation layer is reducible, an outside of a lamination element assembly can be formed small.

[0024]

[Embodiment of the Invention]Hereafter, one embodiment of this invention is described based on a drawing.

[0025]It is a sectional view of the direction [ in / drawing 3 can set the appearance perspective view and drawing 2 in which a lamination duplexer element / in / in drawing 1 / a 1st embodiment of this invention / is shown to the equivalent circuit, can be set in the exploded perspective view, and / in drawing 4 / drawing 3 ] of A-A line strabism. In this embodiment, an example of a lamination duplexer element used when the both sides of a sending circuit and a receiving circuit using frequency different, respectively use one antenna is explained.

[0026]In the figure, 100 is a lamination duplexer element, it consists of the lamination element assembly 110 of rectangular parallelepiped shape in which the resonant-line way was formed in the internal layer, it extends on the upper surface 112 from the bottom 111 in the outside surface of this lamination element assembly 110, and the external terminals 121-128 are formed. The external terminal 121 is a terminal connected to an antenna. The external terminals 122 are a terminal connected to a receiving circuit, and a terminal to which the external terminal 123 is connected in a sending circuit. The other external terminals 124-128 are earthing terminals.

[0027]As shown in the equivalent circuit of drawing 2, the filter circuit 130 for reception and the filter circuit 140 for transmission are formed in the inside of the lamination element assembly 110.

[0028]The filter circuits 130 for reception are bandpass type filters which pass the high frequency signal within a 2.08-2.20-GHz zone (the 1st round is a number zone), and are constituted by the three resonators 131-133, and the inductors 134a and 134h and the capacitors 134b-134i.

[0029]In the filter circuit 130 for reception, one end of the resonator 131 is grounded, it is connected to one end of the capacitor 134b, and the other end is connected to the external terminal 121 for antennas via the inductor 134a. One end of the resonator 132 is grounded and the other end is connected to each one end of the capacitors 134d and 134e. One end of the resonator 133 is grounded, it is connected to one end of the capacitor 134i, and the other end is connected to the external terminal 122 for reception via the inductor 134h. One end of the capacitor 134e is connected to the capacitors [ 134b and 134d ] other end, and the other end of the capacitor 134e is connected to the capacitors [ 134f and 134g ] other end.

[0030]The filter circuits 140 for transmission are bandpass type filters which pass the high frequency signal within a 1.90-2.02-GHz zone (the 2nd frequency band), and are constituted by the three resonators 141-143, and the capacitors 144a-144c and the inductors 144d.

[0031]In the filter circuit 140 for transmission, one end of the resonator 141 is grounded and the other end is connected to the external terminal 123 for transmission via the capacitor 144a. One end of the resonator 142 is grounded, it is connected to the external terminal 123 via the capacitor 144b, and the other end is connected to the external terminal 121 for antennas via the capacitor 144c. One end of the resonator 143 is grounded and the other end is connected to the external terminal 121 for antennas via the inductor 144d. Here, between the resonator 141 and the resonator 142, it has mutual-inductance M, and has mutual-inductance M between the resonator 142 and the

resonator 143.

[0032]Each of the above-mentioned filter circuit 130 for reception and the filter circuit 140 for transmission comprises the piece of a conductor and resonant-line way which were established in the lamination element assembly 110. That is, as shown in drawing 3, the lamination element assembly 110 laminates two or more dielectric layers (insulation layer) 151-166 which have the respectively same thickness, and is constituted, and the resonant-line way, the piece of a conductor, or the ground conductor is formed in the surface at the dielectric layer of the predetermined layer.

[0033]In drawing 3, the top layer and the dielectric layer 151,153 of the 3rd layer are dummy layers, and the ground conductor 171 is formed in the surface of the dielectric layer 152 of the 2nd layer. It is connected to the external terminals 124-128 used as an earthing terminal, and this ground conductor 171 cuts and lacks the portion corresponding to the external terminals 121-123 for the insulation.

[0034]The piece 172 of a conductor which combines with the resonant-line way 174,175 later mentioned in the prescribed position of the surface of the dielectric layer 154 of the 4th layer, and forms a capacitor is formed.

[0035]The three resonant-line ways 173,174,175 which open a prescribed interval in the surface of the dielectric layer 155 of the 5th layer, and consist of the parallel strip lines mutually are formed, each one end is grounded, and the other end is opened wide. One end of the connected conductors 176 is connected to the end part prescribed position of the resonant-line way 173, and the other end of the connected conductors 176 is connected to the external terminal 121 for antennas. One end of the connected conductors 177 is connected to the end part prescribed position of the resonant-line way 175, and the other end of the connected conductors 177 is connected to the external terminal 122 for reception.

[0036]The piece 178 of a conductor which combines with the prescribed position of the surface of the dielectric layer 156 of the 6th layer on the resonant-line way 173,174, and forms a capacitor is formed.

[0037]The dielectric layer 157 of the 7th layer is a dummy layer.

[0038]The ground conductor 179 is formed in the surface of the dielectric layer 158 of the 8th layer. It is connected to the external terminals 124-128 used as an earthing terminal, and this ground conductor 179 cuts and lacks the portion corresponding to the external terminals 121-123 for the insulation.

[0039]The 9th and the dielectric layer 159,160 of the 10th layer are dummy layers.

[0040]The piece 180 of a conductor is formed in the surface of the dielectric layer 161 of the 11th layer, one end of the piece 180 of a conductor is connected to the external

terminal 123 for transmission, and the other end is arranged at the position which combines with the open end part of the resonant-line way 183 mentioned later, and forms capacitance.

[0041]The three resonant-line ways 181,182,183 which open a prescribed interval in the surface of the dielectric layer 162 of the 12th layer, and consist of the parallel strip lines mutually are formed, each one end is grounded, and the other end is opened wide. One end of the connected conductors 184 is connected to the end part prescribed position of the resonant-line way 181, and the other end of the connected conductors 184 is connected to the external terminal 121 for antennas. These resonant-line ways 181,182,183 are parallel to the above-mentioned resonant-line way 173,174,175, and they are arranged so that a ground edge and an open end may be in agreement.

[0042]The piece 185 of a conductor of the rectangle which combines with the open end of the resonant-line way 181,182,183 in the prescribed position of the surface of the dielectric layer 163 of the 13th layer, and forms capacitance is formed.

[0043]The 14th and the dielectric layer 164,165 of the 15th layer are dummy layers.

[0044]The ground conductor 186 is formed in the surface of the dielectric layer 166 of the 16th layer. It is connected to the external terminals 124-128 used as an earthing terminal, and this ground conductor 186 cuts and lacks the portion corresponding to the external terminals 121-123 for the insulation.

[0045]The filter circuit 130 for reception is constituted from the lamination element assembly 110 mentioned above by the resonant-line way established in the surface of the dielectric layers 152-158 of the 2nd to 8th layer, and these layers, a ground conductor, and the piece of a conductor, The filter circuit 140 for transmission is constituted by the resonant-line way established in the surface of the dielectric layers 158-166 of the 8th to 16th layer, and these layers, the ground conductor, and the piece of a conductor.

[0046]Since the resonant-line way 173,174,175 and the piece 172,176,177,178 of a conductor from which the above-mentioned lamination duplexer element 100 constitutes the filter circuit 130 for reception are inserted by the ground conductor 171,179 via the dielectric layer 152,153,156,157, The filter circuit 130 for reception is covered from the external world and the filter circuit 140 for transmission by this ground conductor 171,179, Since the resonant-line way 181,182,183 and the piece 180,184,185 of a conductor which constitute the filter circuit 140 for transmission are inserted by the ground conductor 179,186 via the dielectric layers 158, 159, and 160,163,164,165, The filter circuit 140 for transmission is covered from the external world and the filter circuit 130 for reception by this ground conductor 179,186. Thereby,

each filter circuit 130,140 can demonstrate the good characteristic, without receiving the electric influence of the filter circuit of the external world and another side.

[0047]Since one or more of the resonant-line way which constitutes the filter circuit 130 for reception, a ground conductor, and the pieces of a conductor are provided in a different layer from the layer in which the resonant-line way, the piece of a conductor, and ground conductor of the filter circuit 140 for transmission are formed, The thickness of each insulation layer and the distance of a resonant-line way and a ground conductor can be set up so that the best characteristic can be obtained for every filter. Thereby, the impedance characteristic of the band pass of each filter circuit 130,140 can be set as the optimal state.

[0048]In each of the filter circuit 130 for reception, and the filter circuit 140 for transmission, the frequency characteristic of the above-mentioned lamination duplexer element 100 shows the good frequency characteristic, as shown in drawing 5. That is, as shown in the characteristic curve of Rx of drawing 5, the filter circuit 130 for reception shows a good transit characteristic in the frequency band for reception, and is producing big attenuation in addition to the frequency band for reception. As shown in the characteristic curve of Tx of drawing 5, the filter circuit 140 for transmission shows a good transit characteristic in the frequency band for transmission, and is producing big attenuation in addition to the frequency band for transmission.

[0049]As for the above-mentioned lamination duplexer element 100, since the portion of the filter circuit 130 for reception and the portion of the filter circuit 140 for transmission are perpendicularly laminated to the bottom 111 of the lamination element assembly 110, the packaging areas to the main unit are reduced and high density assembly becomes possible.

[0050]In a 1st embodiment. The distance between the two ground conductors 179,186 which face across the resonant-line way 181,182,183 in the filter circuit 140 for transmission rather than the distance between the two ground conductors 171,179 which face across the resonant-line way 173,174,175 in the filter circuit 130 for reception. Set up so that the impedance characteristic of the band pass of each filter circuit 130,140 may be in a good state by setting up greatly, but. It is preferred for it not to be limited to this and to set up arbitrarily individually by arrangement of the resonant-line way in each filter circuit 130,140 or the piece of a conductor.

[0051]Next, a 2nd embodiment of this invention is described.

[0052]The appearance perspective view and drawing 7 in which the lamination duplexer element [ in / in drawing 6 / a 2nd embodiment ] 200 is shown are the exploded perspective view. In a figure, a 1st embodiment and the identical configuration portion

which were mentioned above are expressed with identical codes, and omit the explanation. The point of difference between a 2nd embodiment and a 1st embodiment, The resonant-line way 181,182,183 which constitutes the filter circuit 140 for transmission, It is having arranged so that arrangement of the piece 180,185 of a conductor and the connecting line 184 may be changed and the resonant-line way's 181,182,183 may cross right-angled to the resonant-line way 173,174,175 of the filter circuit 130 for reception.

[0053]The same effect as a 1st embodiment is acquired by the above-mentioned composition, and The external terminal 121 for antennas, Since each of the external terminal 122 for reception and the external terminal 123 for transmission can be easily formed in the side in which the lamination element assemblies 110 differ, Generating of a short circuit of these external terminals 121,122,123 can be prevented, and the shape of the lamination element assembly 110 can be miniaturized, making the size of the external terminal 121,122,123 into the same size as a 1st embodiment.

[0054]Next, a 3rd embodiment of this invention is described.

[0055]Drawing 8 is an exploded perspective view of the lamination duplexer element 300 in a 3rd embodiment. The appearance and the equivalent circuit of a lamination duplexer element in a 3rd embodiment are the same as a 1st embodiment mentioned above.

[0056]The point of difference between a 3rd embodiment and a 1st embodiment, In a 3rd embodiment, provide 311, and as shown in drawing 9, as shown in drawing 10, a ground conductor, so that the external terminal 123 for transmission may be surrounded between the external ends 123 for transmission as the resonant-line way 173,174,175 of the filter circuit 130 for reception on the surface of the dielectric layer 155 of the 5th layer, It is having formed the ground conductor for 321 in the surface of the dielectric layer 162 of the 12th layer so that the external terminal 122 for reception might be surrounded between the resonant-line way 181,182,183 of the filter circuit 140 for transmission, and the carrier trust external end 122.

[0057]by the above-mentioned composition, the same effect as a 1st embodiment can be acquired, and the electric combination between the resonant-line way 173,174,175 of the filter circuit 130 for reception and the external terminal 123 for transmission is controlled by the ground conductor 311. The electric combination between the resonant-line way 181,182,183 of the filter circuit 140 for transmission and the external terminal 122 for reception is controlled by the ground conductor 321. The characteristic of each filter circuit 130,140 can be set up individually by this, without being influenced by the filter circuit of another side, and the characteristic can be stabilized.

[0058]May form the ground conductor 312,313 surrounding the external terminal 123 for transmission also in the surface of the dielectric layer 154,156 in which other pieces 172,178 of a conductor which constitute the filter circuit 130 for reception are formed like the lamination duplexer element 300A shown in drawing 11, and, The ground conductor 322,323 surrounding the external terminal 122 for reception may be formed also in the surface of the dielectric layer 161,163 in which other pieces 180,185 of a conductor which constitute the filter circuit 140 for transmission are formed.

[0059]Only the ground conductor 321,322,323 surrounding the external terminal 122 for reception may be formed, and only the ground conductor 311,312,313 surrounding the external terminal 123 for transmission may be formed.

[0060]Although it is preferred to provide in the layer in which the resonant-line way is formed, and a same layer as for the ground conductor surrounding the above-mentioned external terminal 122 for reception or the external terminal 123 for transmission, The layer in particular that forms the above-mentioned ground conductor is not specified, and can acquire the almost same effect by forming the ground conductor surrounding [ any one or more layers ] the above-mentioned external terminal.

[0061]Next, a 4th embodiment of this invention is described.

[0062]Drawing 12 is an exploded perspective view showing the lamination duplexer element 400 in a 4th embodiment, and a sectional view of an A-A arrowed direction [ in / in drawing 13 / drawing 12 ]. In a figure, a 1st embodiment and the identical configuration portion which were mentioned above are expressed with identical codes, and omit the explanation. The point of difference between a 4th embodiment and a 1st embodiment, In a 4th embodiment, form the capacitance of a predetermined quantity between the open end part of the resonant-line way 173,174,175 of the filter circuit 130 for reception, and a ground conductor, and aim at shortening of the resonant-line way 173,174,175, and improvement in Q of the filter circuit 130, and. It is having formed the capacitance of a predetermined quantity between the open end part of the resonant-line way 181,182,183 of the filter circuit 140 for transmission, and the ground conductor, and having aimed at shortening of the resonant-line way 181,182,183, and improvement in Q of the filter circuit 140. It enabled it to obtain the above-mentioned capacitance by arranging in a layer which divides into two the ground conductor arranged at the layer between the resonant-line way 173,174,175 and the resonant-line way 181,182,183, and is different, respectively.

[0063]Namely, in the lamination duplexer element 400 of a 4th embodiment. The position of the ground edge of the resonant-line way 173,174,175 of the filter circuit 130 for reception and an open end has arranged the resonant-line way 173,174,175 of the

filter circuit 130 for reception, the piece 172,178 of a conductor, and the connected conductors 176,177 so that a 1st embodiment may become opposite. The 8th and the dielectric layer 158,159 of the 9th layer in a 1st embodiment were removed.

[0064]about [ to which the lamination duplexer element 400 of a 4th embodiment hits the open end side of the resonant-line way 173,174,175 on the surface of the dielectric layer 157 of the 7th layer ] -- the ground conductor 411 was formed in one half of fields, and two or more beerhole conductors 412 connected to the ground conductor 411 were formed. The ground conductor 421 was formed in about 1-/the field two which hits the open end side of the resonant-line way 181,182,183 on the surface of the dielectric layer 160 of the 8th layer. The ground conductor 411 and the ground conductor 412 are connected via two or more beerhole conductors 412.

[0065]By the above-mentioned composition, the distance L1 between the resonant-line way 173,174,175 of the filter circuit 130 for reception and the ground conductor 411 is set up smaller than the distance L2 between the resonant-line way 181,182,183 of the filter circuit 140 for transmission, and the ground conductor 411. The distance L3 between the resonant-line way 181,182,183 of the filter circuit 140 for transmission and the ground conductor 421 is set up smaller than the distance L4 between the resonant-line way 173,174,175 of the filter circuit 130 for reception, and the ground conductor 421.

[0066]For this reason, since capacitance occurs between the open end part of the resonant-line way 173,174,175 of the filter circuit 130 for reception, and the ground conductor 411, the length of the resonant-line way 173,174,175 can be shortened, and Q of the filter circuit 130 for reception can be raised. Since capacitance occurs between the open end part of the resonant-line way 181,182,183 of the filter circuit 140 for transmission, and the ground conductor 421, the length of the resonant-line way 181,182,183 can be shortened, and Q of the filter circuit 140 for transmission can be raised.

[0067]Since it is connected via the beerhole conductor 412 in the portion which each of the ground conductor 411,421 is provided in one half of the fields of a side to which the dielectric layers 157,160 differ mutually, and each overlaps, These two ground conductors 411,421 can perform electric cover between the filter circuit 130 for reception, and the filter circuit 140 for transmission.

[0068]The miniaturization of the lamination duplexer element 400 can be attained by shortening of the length of the resonant-line way 173,174,175 of the filter circuit 130 for reception, and the resonant-line way 181,182,183 of the filter circuit 140 for transmission, and reduction of dielectric layers.

[0069]It cannot be overemphasized that the same effect as a 1st embodiment can be acquired also in a 4th embodiment.

[0070]Next, a 5th embodiment of this invention is described.

[0071]The appearance perspective view showing the lamination duplexer element [ in / in drawing 14 / a 5th embodiment ] 500, the sectional view of an A-A arrowed direction [ in / in drawing 15 / drawing 14 ], and drawing 16 are the exploded perspective view. In this embodiment, an example of the lamination duplexer element which is a lamination duplexer element, and component part puts in order component part and the filter circuit 140 for transmission, and is formed in the filter circuit 130 for reception which has the same equivalent circuit and frequency characteristic as a 1st embodiment is explained.

[0072]In the figure, 500 is a lamination duplexer element, it consists of the lamination element assembly 510 of rectangular parallelepiped shape in which the resonant-line way was formed in the internal layer, it extends on the upper surface 512 from the bottom 511 in the outside surface of this lamination element assembly 510, and the external terminals 521-528 are formed. The external terminal 521 is a terminal connected to an antenna. The external terminals 522 are a terminal connected to a receiving circuit, and a terminal to which the external terminal 523 is connected in a sending circuit. The other external terminals 524-528 are earthing terminals.

[0073]The filter circuit 130 for reception shown in the equivalent circuit of drawing 2 mentioned above and the filter circuit 140 for transmission are formed in the inside of the lamination element assembly 510.

[0074]Each of the above-mentioned filter circuit 130 for reception and the filter circuit 140 for transmission comprises the piece of a conductor and resonant-line way which were established in the lamination element assembly 510. That is, as shown in drawing 16, the lamination element assembly 510 laminates two or more dielectric layers (insulation layer) 551-560 which have a flat surface of the respectively same thickness and a rectangle, and is constituted, and the resonant-line way, the piece of a conductor, or the ground conductor is formed in the surface at the dielectric layer of the predetermined layer.

[0075]In drawing 16, the dielectric layer 551 of the top layer is a dummy layer, and the ground conductor 571 is formed in the surface of the dielectric layer 552 of the 2nd layer to one half by the side of the long side direction end of fields. It is connected to the external terminal 524,525,528 used as an earthing terminal, and this ground conductor 571 cuts and lacks the object for antennas, and the portion corresponding to the external terminal 521,523 for transmission for the insulation.

[0076]The dielectric layer 553 of the 3rd layer is a dummy layer.

[0077]In the surface of the dielectric layer 554 of the 4th layer, the ground conductor 572 is formed in one half of the fields by the side of the long side direction other end. It is connected to the external terminal 526,527,528 used as an earthing terminal, and this ground conductor 572 cuts and lacks the object for antennas, and the portion corresponding to the external terminal 521,522 for reception for the insulation.

[0078]The piece 573 of a conductor is formed in the surface of the dielectric layer 555 of the 5th layer, one end of the piece 573 of a conductor is connected to the external terminal 523 for transmission, and the other end is arranged at the position which combines with the open end part of the resonant-line way 577 mentioned later, and forms capacitance.

[0079]The piece 574 of a conductor which combines with the resonant-line way 581,582 which the other end side of a long side direction mentions later to the prescribed position in one half of fields, and forms a capacitor is formed in the surface of the dielectric layer 556 of the 6th layer. The three resonant-line ways 575,576,578 which open a prescribed interval into one half of fields in the one end side of a long side direction, and consist of the parallel strip lines mutually are established in the surface of the dielectric layer 556 of the 6th layer, each one end is grounded, and the other end is opened wide. One end of the connected conductors 579 is connected to the end part prescribed position of the resonant-line way 575, and the other end of the connected conductors 579 is connected to the external terminal 521 for antennas. These resonant-line ways 575,576,578 are arranged so that it may become parallel to the shorter side of the dielectric layer 556.

[0080]The three resonant-line ways 580,581,582 which open a prescribed interval in the prescribed position in one half of fields in the other end side of a long side direction, and consist of the parallel strip lines mutually are established in the surface of the dielectric layer 557 of the 7th layer, Each one end of these resonant-line ways 580,581,582 is grounded, and the other end is opened wide. One end of the connected conductors 583 is connected to the end part prescribed position of the resonant-line way 580, and the other end of the connected conductors 583 is connected to the external terminal 521 for antennas. One end of the connected conductors 584 is connected to the end part prescribed position of the resonant-line way 582, and the other end of the connected conductors 584 is connected to the external terminal 522 for reception.

[0081]The piece 585 of a conductor of the rectangle as for which the end side of a long side direction combines with the open end of the resonant-line way 575,576,578 in the prescribed position in one half of fields and which forms capacitance is formed in the

surface of the dielectric layer 557 of the 7th layer.

[0082]The piece 586 of a conductor which combines with the surface of the dielectric layer 558 of the 8th layer in the prescribed position in one half of fields at the resonant-line way 580,581 in the other end side of a long side direction, and forms a capacitor is formed.

[0083]The dielectric layer 559 of the 9th layer is a dummy layer.

[0084]The whole region is covered mostly and the ground conductor 587 is formed in the surface of the dielectric layer 560 of the 10th layer. It is connected to the external terminals 524-528 used as an earthing terminal, and this ground conductor 587 cuts and lacks the portion corresponding to the external terminals 521-523 for the insulation.

[0085]The filter circuit 130 for reception is constituted from the lamination element assembly 510 mentioned above by the resonant-line way which was established in one half of fields as for the other end side of a long side direction, a ground conductor, and the piece of a conductor, The filter circuit 140 for transmission is constituted by the resonant-line way which was established in one half of fields as for the end side of a long side direction, the ground conductor, and the piece of a conductor.

[0086].It is set as the value from which the distance L5 between the two ground conductors 572,587 which face across the resonant-line way 580,581,582 in the filter circuit 130 for reception, and distance L6 between the two ground conductors 571,787 which face across the resonant-line way 575,576,577 in the filter circuit 140 for transmission differ. One or more of the resonant-line way which constitutes the filter circuit 130 for reception, a ground conductor, and the pieces of a conductor are provided in a different layer from the layer in which the resonant-line way, the piece of a conductor, and ground conductor of the filter circuit 140 for transmission are formed. Thereby, in each of the object for reception, and the filter circuit 130,140 for transmission, the impedance characteristic of a band pass can be set as the optimal state.

[0087]Since the resonant-line way 580,581,582 and the piece 574,583,584,586 of a conductor which constitute the filter circuit 130 for reception are inserted by the ground conductor 572,587 via the dielectric layer 554,555,558,559, The filter circuit 130 for reception is covered from the external world and the filter circuit 140 for transmission by this ground conductor 582,587, Since the resonant-line way 575,576,577 and the pieces 573 and 579585 of a conductor which constitute the filter circuit 140 for transmission are inserted by the ground conductor 571,587 via the dielectric layers 552, 553, and 554,557,558,559, The filter circuit 140 for transmission is covered from the external world and the filter circuit 130 for reception by this ground conductor 571,587.

Thereby, each filter circuit 130,140 can demonstrate the good characteristic, without receiving the electric influence of the filter circuit of the external world and another side.

[0088]The lamination duplexer element 500 of a 5th embodiment, Since the portion of the filter circuit 130 for reception and the portion of the filter circuit 140 for transmission arrange and are arranged on the bottom 511 of the lamination element assembly 510, the height of the lamination duplexer element 500 can be set up low, and it becomes applicable to thin electronic equipment.

[0089]In a 5th embodiment of the above. The distance between the two ground conductors 571,587 which face across the resonant-line way 575,576,576 in the filter circuit 140 for transmission rather than the distance between the two ground conductors 572,587 which face across the resonant-line way 580,581,582 in the filter circuit 130 for reception. Set up so that the impedance characteristic of the band pass of each filter circuit 130,140 may be in a good state by setting up greatly, but. It is preferred for it not to be limited to this and to set up arbitrarily individually by arrangement of the resonant-line way in each filter circuit 130,140 or the piece of a conductor.

[0090]Although the portion pinched, the portion 572,587, i.e., the ground conductor, which constitute the filter circuit 130 for reception, was provided in the bottom 511 side of the lamination element assembly 510 in a 5th embodiment of the above, May provide the portion which constitutes the filter circuit 130 for reception like the lamination duplexer element 500A of a 6th embodiment shown in drawing 17 and drawing 18 in the upper surface 512 side of the lamination element assembly 510, and, The portion which constitutes the filter circuit 130 for reception like the lamination duplexer element 500B of a 7th embodiment shown in drawing 19 and drawing 20 may be provided in the mid-position of the bottom 511 and the upper surface 512 of the lamination element assembly 510.

[0091]The lamination duplexer element 500C provided with the lamination element assembly 510C of staircase shape from which the portion which serves as a dummy layer by the side of the upper surface 512 of the portion which constitutes the filter circuit 130 for reception in the lamination element assembly 510 of a 5th embodiment like an 8th embodiment shown in drawing 21 and drawing 22 was removed may be constituted.

[0092]The portion which constitutes the filter circuit 130 for reception in the lamination duplexer element 500 of a 5th embodiment, and the portion which constitutes the filter circuit 140 for transmission are formed in another layer like a 9th embodiment shown in drawing 23, And the lamination duplexer element 500D arranged so that a part of

portion which constitutes the filter circuit 130 for reception, and a part of portion which constitutes the filter circuit 140 for transmission may lap may be constituted. Thus, even if it arranges so that a part of portion which constitutes the filter circuit 130 for reception, and a part of portion which constitutes the filter circuit 140 for transmission may lap, the electric interference between each filter circuit can be controlled, and the packaging area to the main unit can be reduced.

[0093]The composition of each above-mentioned embodiment is one example of the invention in this application, and it cannot be overemphasized that the invention in this application is not limited only to these composition, and the composition of each embodiment may be combined.

[0094]

[Effect of the Invention]Since according to the lamination duplexer element of this invention according to claim 1 to 8 each of the 1st filter circuit and the 2nd filter circuit is mutually covered by a ground conductor and it is covered from the external world as explained above, The best characteristic in both filter circuits can be obtained. When one or more of the piece of a conductor of the 1st filter circuit and ground conductors provide in a different layer from the layer in which the piece of a conductor and ground conductor of the 2nd filter circuit are formed, Since the thickness of each insulation layer and the distance of a resonant-line way and a ground conductor can be set up for every filter circuit, the best characteristic can be obtained for every filter.

[0095]In [ according to the lamination duplexer element according to claim 2 / in addition to the above-mentioned effect ] each of the 1st filter circuit and the 2nd filter circuit, By setting the distance between two ground conductors which face across a resonant-line way as a different value, the impedance characteristic of the band pass of each filter circuit is set as the best state.

[0096]According to the lamination duplexer element according to claim 3, in the above-mentioned effect In addition, since the ground conductor was formed so that an input/output terminal might be surrounded, You can set up the characteristic of each filter circuit individually, and can make it stabilized since the electric combination between the resonant-line way of the 2nd filter circuit and the 1st input/output terminal or the electric combination between the resonant-line way of the 1st filter circuit and the 2nd input/output terminal is controlled.

[0097]Since the portion of the 1st filter circuit and the portion of the 2nd filter circuit are arranged [ according to the lamination duplexer element according to claim 4 ] in piles in the laminating direction of a lamination element assembly in addition to the above-mentioned effect, the packaging areas to the main unit are reduced and high

density assembly becomes possible.

[0098]Since according to the lamination duplexer element according to claim 5 in addition to the above-mentioned effect the portion of the 1st filter circuit and the portion of the 2nd filter circuit arrange in the direction to which the layer of a lamination element assembly extends and are arranged, The height of a lamination duplexer element can be set up low and it becomes applicable to thin electronic equipment.

[0099]Since according to the lamination duplexer element according to claim 6 it laminates so that a part of portion in which the 1st filter circuit is formed may lap with a part of portion in which the 2nd filter circuit is formed in addition to the above-mentioned effect, The electric interference between each filter circuit can be controlled, and packaging areas can be reduced.

[0100]Since according to the lamination duplexer element according to claim 7 in addition to the above-mentioned effect it is arranged so that the resonant-line way of the resonant-line way of the 1st filter circuit and the 2nd filter circuit may cross right-angled mutually, the input/output terminal of each filter circuit can be easily arranged on the outside surface on which lamination element assemblies differ.

[0101]moreover -- according to the lamination duplexer element according to claim 8 -- the above-mentioned effect -- in addition, since the length of a resonant-line way can be shortened and the number of laminations of an insulation layer is reducible, the outside of a lamination element assembly can be formed small. Q of each filter circuit can be raised.

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[Translation done.]

## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The appearance perspective view showing the lamination duplexer element in a 1st embodiment of this invention

[Drawing 2]The figure showing the equivalent circuit of the lamination duplexer element in a 1st embodiment of this invention

[Drawing 3]The exploded perspective view showing the lamination duplexer element in a 1st embodiment of this invention

[Drawing 4]The sectional view of the direction of A-A line strabism in drawing 3

[Drawing 5]The figure showing the frequency characteristic of the lamination duplexer element in a 1st embodiment of this invention

[Drawing 6]The appearance perspective view showing the lamination duplexer element in a 2nd embodiment of this invention

[Drawing 7]The exploded perspective view showing the lamination duplexer element in a 2nd embodiment of this invention

[Drawing 8]The exploded perspective view showing the lamination duplexer element in a 3rd embodiment of this invention

[Drawing 9]The top view showing the important section in a 3rd embodiment of this invention

[Drawing 10]The top view showing the important section in a 3rd embodiment of this invention

[Drawing 11]The exploded perspective view showing other examples of composition of the lamination duplexer element of a 3rd embodiment of this invention

[Drawing 12]The exploded perspective view showing the lamination duplexer element in a 4th embodiment of this invention

[Drawing 13]The sectional view of the A-A arrowed direction in drawing 12

[Drawing 14]The appearance perspective view showing the lamination duplexer element in a 5th embodiment of this invention

[Drawing 15]The sectional view of the A-A arrowed direction in drawing 14

[Drawing 16]The exploded perspective view showing the lamination duplexer element in a 5th embodiment of this invention

[Drawing 17]The exploded perspective view showing the lamination duplexer element in a 6th embodiment of this invention

[Drawing 18]The sectional view of the A-A arrowed direction in drawing 17

[Drawing 19]The exploded perspective view showing the lamination duplexer element in a 7th embodiment of this invention

[Drawing 20]The sectional view of the A-A arrowed direction in drawing 20

[Drawing 21]The exploded perspective view showing the lamination duplexer element in an 8th embodiment of this invention

[Drawing 22]The sectional view of the A-A arrowed direction in drawing 22

[Drawing 23]The sectional side elevation showing the lamination duplexer element in a 9th embodiment of this invention

[Description of Notations]

100,200,300,300A, 400,500,500A-500D -- Lamination duplexer element, 110,210,510 -- A lamination element assembly, 111,211,511 -- Bottom, 112,212,512 -- The upper surface, 121,521 -- The external terminal for antennas, 122,522 -- The external terminal for reception, 123,523 -- The external terminal for transmission, 124-128,524-528 -- The external terminal for grounding, 130 -- The filter circuit for reception, 131,132,133 -- A resonator, 134a, 134h -- Inductor, 134b, 134d, 134e, 134f, 134g -- Capacitor, 140 -- The filter circuit for transmission, 144a, 144b, 144c -- Capacitor, 144d -- An inductor, 151-166 -- A dielectric layer (insulation layer), 171,179,186 -- Ground conductor, 172,178,180,185 -- The piece of a conductor, 173, 174, 175,181,182,183 -- Resonant-line way, 175,176,184 [ -- A beerhole conductor, 551-560 / -- Dielectric layer (insulation layer), ] -- Connected conductors, 311, 312, 313,321,322,323 -- A ground conductor, 411,421 -- A ground conductor, 412 571, 572, 587, 588, 589,591,592,593 [ -- Connected conductors. ] -- A ground conductor, 573,574,585,586 -- The piece of a conductor, 575, 576, 577,580,581,582 -- A resonant-line way, 579,583,584

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[Translation done.]

## CLAIMS

[Claim(s)]

[Claim 1]The 1st filter circuit that has two or more pieces of a conductor including a resonant-line way, and passes a signal in the 1st frequency band.

A lamination element assembly including the 2nd filter circuit that passes a signal in the 2nd frequency band that has two or more pieces of a conductor including a resonant-line way, and is different from said 1st frequency band.

The 1st input/output terminal that was formed in an outside surface of said lamination element assembly, and was connected to one input output end of said 1st filter circuit.

The 2nd input/output terminal that was formed in an outside surface of said lamination element assembly, and was connected to one input output end of said 2nd filter circuit.

A common input/output terminal which was formed in an outside surface of said lamination element assembly, and was connected to an input output end of another side of said 1st filter circuit, and an input output end of another side of said 2nd filter circuit, and an earthing terminal formed in an outside surface of said lamination element assembly.

Form two or more ground conductors arranged so that a piece of a conductor which is the lamination duplexer element provided with the above, and includes a resonant-line way of said 1st filter circuit, and a piece of a conductor including a resonant-line way of said 2nd filter circuit may be individually inserted via an insulation layer for every filter circuit, and. One or more of a piece of a conductor of said 1st filter circuit and ground conductors are provided in a different layer from a layer in which a piece of a conductor and a ground conductor of said 2nd filter circuit are formed.

[Claim 2]The lamination duplexer element according to claim 1, wherein distance

between two ground conductors which face across a resonant-line way of said 1st filter circuit is set as a different value from distance between two ground conductors which face across a resonant-line way of said 2nd filter circuit.

[Claim 3]In [ a resonant-line way and said 1st input/output terminal of between a resonant-line way of said 1st filter circuit, and said 2nd input/output terminal, or said 2nd filter circuit / between ] either at least, The lamination duplexer element according to claim 1 or 2 forming a ground conductor connected to said earthing terminal so that said input/output terminal might be surrounded in one or more layers.

[Claim 4]The lamination duplexer element according to any one of claims 1 to 3 which said lamination element assembly arranges in piles a portion in which said 1st filter circuit was formed, and a portion in which said 2nd filter circuit was formed to a laminating direction, and is characterized by things.

[Claim 5]The lamination duplexer element according to any one of claims 1 to 3 which said lamination element assembly puts in order a portion in which said 1st filter circuit is formed, and a portion in which said 2nd filter circuit is formed in the direction to which a layer extends, arranges it, and is characterized by things.

[Claim 6]The lamination duplexer element according to any one of claims 1 to 3, wherein, as for said lamination element assembly, a part of portion in which said 2nd filter circuit is formed comes to laminate a part of portion in which said 1st filter circuit is formed.

[Claim 7]Said resonant-line way consists of a piece of a beltlike conductor by which one end was connected to said earthing terminal, and the other end was opened wide, The lamination duplexer element according to claim 4, wherein a resonant-line way of said 1st filter circuit is arranged so that it may cross right-angled via an insulation layer to a resonant-line way of said 2nd filter circuit.

[Claim 8]Said resonant-line way consists of a piece of a beltlike conductor by which one end was connected to said earthing terminal, and the other end was opened wide, and. Each resonant-line way is arranged so that one end of a resonant-line way of said 1st filter circuit may be located in the other end side of a resonant-line way of said 2nd filter circuit and the other end of a resonant-line way of said 1st filter circuit may be located in the one end side of a resonant-line way of said 2nd filter circuit, As a ground conductor formed so that said piece of a conductor might be inserted via an insulation layer, It is arranged between a resonant-line way of said 1st filter circuit, and a resonant-line way of said 2nd filter circuit, It has the 1st and 2nd ground conductors formed in a mutually different layer, Said 1st ground conductor is formed in one half by the side of an open end part of a resonant-line way of said 1st filter circuit of fields, and

said 2nd ground conductor is formed in one half by the side of an open end part of a resonant-line way of said 2nd filter circuit of fields, Distance between a resonant-line way of said 1st filter circuit and said 1st ground conductor is set up smaller than distance between a resonant-line way of said 2nd filter circuit, and said 1st ground conductor, and distance between a resonant-line way of said 2nd filter circuit and said 2nd ground conductor, The lamination duplexer element according to claim 4 setting up smaller than distance between a resonant-line way of said 1st filter circuit, and said 2nd ground conductor.

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[Translation done.]

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(71)出願人　000204284
太陽誘電株式会社
東京都台東区上野6丁目16番20号
(72)発明者　井上　真
東京都台東区上野6丁目16番20号　太陽誘電株式会社内
(74)代理人　100069981
弁理士　吉田　精孝　（外1名）

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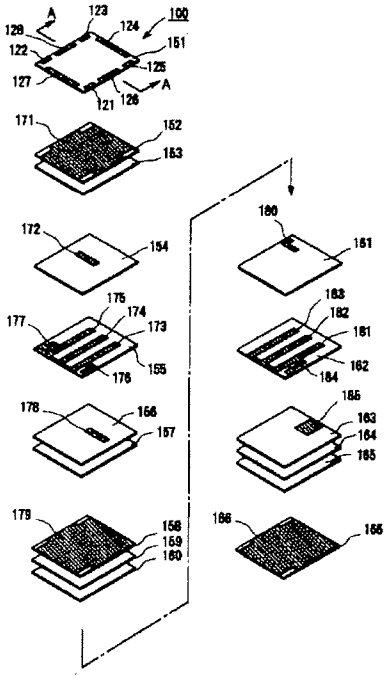
(54)【発明の名称】積層デュプレクサ素子

(57)【要約】
【課題】　各フィルタ回路において最良の周波数特性を設定することができる積層デュプレクサ素子を提供する。
【解決手段】　共振線路173,174,175を含む複数の導体片172,176,177,178を誘電体層152～157を介して挟むように設けられた接地導体171,179とを有し第１周波数帯域内の信号を通過させる受信用フィルタ回路と、共振線路181,182,183を含む複数の導体片180,185を誘電体層158～165を介して挟むように設けられた接地導体179,186とを有し第１周波数帯域とは異なる第２周波数帯域内の信号を通過させる送信用フィルタ回路とを備え、受信用フィルタ回路の導体片及び接地導体のうちの１つ以上が送信用フィルタ回路の導体片及び接地導体が設けられている層とは異なる層に設けられている積層デュプレクサ素子を構成する。



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【特許請求の範囲】

【請求項１】　共振線路を含む複数の導体片を有し第１周波数帯域内の信号を通過させる第１フィルタ回路と、共振線路を含む複数の導体片を有し前記第１周波数帯域とは異なる第２周波数帯域内の信号を通過させる第２フィルタ回路とを含む積層素体と、前記積層素体の外面に形成され前記第１フィルタ回路の一方の入出力端に接続された第１入出力端子と、前記積層素体の外面に形成され前記第２フィルタ回路の一方の入出力端に接続された第２入出力端子と、前記積層素体の外面に形成され前記第１フィルタ回路の他方の入出力端と前記第２フィルタ回路の他方の入出力端とに接続された共通入出力端子と、前記積層素体の外面に形成された接地端子とを備えてなる積層デュプレクサ素子において、

前記第１フィルタ回路の共振線路を含む導体片と前記第２フィルタ回路の共振線路を含む導体片を各フィルタ回路毎に個別に絶縁体層を介して挟むように配置された複数の接地導体とを設けると共に、

前記第１フィルタ回路の導体片及び接地導体のうちの１つ以上が、前記第２フィルタ回路の導体片及び接地導体が設けられている層とは異なる層に設けられていることを特徴とする積層デュプレクサ素子。

【請求項２】　前記第１フィルタ回路の共振線路を挟む２つの接地導体間の距離が、前記第２フィルタ回路の共振線路を挟む２つの接地導体間の距離と異なる値に設定されていることを特徴とする請求項１に記載の積層デュプレクサ素子。

【請求項３】　前記第１フィルタ回路の共振線路と前記第２入出力端子との間或いは前記第２フィルタ回路の共振線路と前記第１入出力端子との間の少なくとも何れか一方において、１つ以上の層に、前記入出力端子を囲むように前記接地端子に接続された接地導体を設けたことを特徴とする請求項１または請求項２に記載の積層デュプレクサ素子。

【請求項４】　前記積層素体は、前記第１フィルタ回路が形成された部分と、前記第２フィルタ回路が形成された部分とを積層方向に重ねて配置してなることを特徴とする請求項１乃至請求項３の何れかに記載の積層デュプレクサ素子。

【請求項５】　前記積層素体は、前記第１フィルタ回路が形成される部分と、前記第２フィルタ回路が形成される部分を層が延びる方向に並べて配置してなることを特徴とする請求項１乃至請求項３の何れかに記載の積層デュプレクサ素子。

【請求項６】　前記積層素体は、前記第１フィルタ回路が形成される部分の一部分が、前記第２フィルタ回路が形成される部分の一部分に積層されてなることを特徴とする請求項１乃至請求項３の何れかに記載の積層デュプレクサ素子。

【請求項７】　前記共振線路は一端が前記接地端子に接続され他端が開放された帯状導体片からなり、

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前記第１フィルタ回路の共振線路が、前記第２フィルタ回路の共振線路に対して絶縁体層を介して直角に交差するように配置されていることを特徴とする請求項４に記載の積層デュプレクサ素子。

【請求項８】　前記共振線路は一端が前記接地端子に接続され他端が開放された帯状導体片からなると共に、前記第１フィルタ回路の共振線路の一端が前記第２フィルタ回路の共振線路の他端側に位置し且つ前記第１フィルタ回路の共振線路の他端が前記第２フィルタ回路の共振線路の一端側に位置するように各共振線路が配置され、前記導体片を絶縁体層を介して挟むように設けられた接地導体として、前記第１フィルタ回路の共振線路と前記第２フィルタ回路の共振線路との間に配置され、互いに異なる層に設けられた第１及び第２の接地導体を備え、前記第１接地導体は前記第１フィルタ回路の共振線路の開放端部側の１／２の領域に設けられていると共に前記第２接地導体は前記第２フィルタ回路の共振線路の開放端部側の１／２の領域に設けられており、

前記第１フィルタ回路の共振線路と前記第１接地導体との間の距離が、前記第２フィルタ回路の共振線路と前記第１接地導体との間の距離よりも小さく設定されていると共に、

前記第２フィルタ回路の共振線路と前記第２接地導体との間の距離が、前記第１フィルタ回路の共振線路と前記第２接地導体との間の距離よりも小さく設定されていることを特徴とする請求項４に記載の積層デュプレクサ素子。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、自動車電話や携帯型電話機等に用いられる積層デュプレクサ素子に関する。

【０００２】

【従来の技術】従来、携帯型電話機では、１つのアンテナを用いて異なる２つの周波数帯域の周波数のそれぞれを送信用及び受信用として通信を行うためにデュプレクサを使用することがある。

【０００３】この種のデュプレクサは、互いに異なる周波数帯域の信号を通過させる２つのフィルタ回路を備え、一方のフィルタ回路が受信用の周波数帯域の信号を通過させるように設定に設定され、他方のフィルタ回路が送信用の周波数帯域の信号を通過させるように設定されている。また、フィルタ回路には、例えば特開平５－２６７９０９号公報に開示されるような同軸型の誘電体共振器が用いられていた。

【０００４】しかし、近年の電子機器の小型化に伴い携帯型電話機も小型化と軽量化が望まれ、電子回路を構成する電子部品も小型化の必要性が生じて、前述したような同軸型誘電体共振器を用いたデュプレクサでは、小型

化を図るには限界があった。

【０００５】デュプレクサのさらなる小型化を図るために、ストリップライン等の導体片によってフィルタ回路を構成した積層型のデュプレクサが提案された（特開平６－８５５０６号公報、特開平１１－１２２００７号公報）。

【０００６】

【発明が解決しようとする課題】しかしながら、前述した従来例の積層型のデュプレクサでは、２つのフィルタ回路間の電気的影響や外界からの電気的影響を受けやすく、双方のフィルタ回路において良好な特性を得ることが困難であった。また、一方のフィルタ回路の特性が良好な状態になるように各絶縁体層の材質や厚さ及び共振線路と接地導体との距離を設定すると、他方のフィルタ回路の特性として最良の特性が得られないことがあった。

【０００７】本発明の目的は上記の問題点に鑑み、各フィルタ回路において最良の周波数特性を設定することができる積層デュプレクサ素子を提供することである。

【０００８】

【課題を解決するための手段】本発明は上記の目的を達成するために請求項１では、共振線路を含む複数の導体片を有し第１周波数帯域内の信号を通過させる第１フィルタ回路と、共振線路を含む複数の導体片を有し前記第１周波数帯域とは異なる第２周波数帯域内の信号を通過させる第２フィルタ回路とを含む積層素体と、前記積層素体の外面に形成され前記第１フィルタ回路の一方の入出力端に接続された第１入出力端子と、前記積層素体の外面に形成され前記第２フィルタ回路の一方の入出力端に接続された第２入出力端子と、前記積層素体の外面に形成され前記第１フィルタ回路の他方の入出力端と前記第２フィルタ回路の他方の入出力端とに接続された共通入出力端子と、前記積層素体の外面に形成された接地端子とを備えてなる積層デュプレクサ素子において、前記第１フィルタ回路の共振線路を含む導体片と前記第２フィルタ回路の共振線路を含む導体片を各フィルタ毎に個別に絶縁体層を介して挟むように配置された複数の接地導体とを設けると共に、前記第１フィルタ回路の導体片及び接地導体のうちの１つ以上が、前記第２フィルタ回路の導体片及び接地導体が設けられている層とは異なる層に設けられている積層デュプレクサ素子を提案する。

【０００９】該積層デュプレクサ素子によれば、前記第１フィルタ回路の共振線路を含む導体片が絶縁体層を介して接地導体によって挟まれるため、該接地導体によって前記第１フィルタ回路は外界及び前記第２フィルタ回路から遮蔽される。さらに、前記第２フィルタ回路の共振線路を含む導体片が絶縁体層を介して接地導体によって挟まれるため、該接地導体によって前記第２フィルタ回路は外界及び前記第１フィルタ回路から遮蔽される。また、前記第１フィルタ回路の導体片及び接地導体のうちの１つ以上が、前記第２フィルタ回路の導体片及び接地導体が設けられている層とは異なる層に設けることにより、各フィルタ毎に最良の特性を得られるように、各絶縁体層の厚さや共振線路と接地導体との距離を設定することができる。

【００１０】また、請求項２では、請求項１に記載の積層デュプレクサ素子において、前記第１フィルタ回路の共振線路を挟む２つの接地導体間の距離が、前記第２フィルタ回路の共振線路を挟む２つの接地導体間の距離と異なる値に設定されている積層デュプレクサ素子を提案する。

【００１１】該積層デュプレクサ素子によれば、前記第１フィルタ回路と第２フィルタ回路のそれぞれにおいて、共振線路を挟む２つの接地導体間の距離が異なる値に設定され、各フィルタ回路の通過周波数帯域のインピーダンス特性が設定される。

【００１２】また、請求項３では、請求項１または請求項２に記載の積層デュプレクサ素子において、前記第１フィルタ回路の共振線路と前記第２入出力端子との間或いは前記第２フィルタ回路の共振線路と前記第１入出力端子との間の少なくとも何れか一方において、１つ以上の層に、前記入出力端子を囲むように前記接地端子に接続された接地導体を設けた積層デュプレクサ素子。

【００１３】該積層デュプレクサ素子によれば、前記第１フィルタ回路の共振線路と前記第２入出力端子との間に前記第２入出力端子を囲むように前記接地端子に接続された接地導体が設けられると、前記第１フィルタ回路の共振線路と前記第２入出力端子との間の電気的な結合が抑制される。また、前記第２フィルタ回路の共振線路と前記第１入出力端子との間に前記第１入出力端子を囲むように前記接地端子に接続された接地導体が設けられると、前記第２フィルタ回路の共振線路と前記第１入出力端子との間の電気的な結合が抑制される。これにより、各フィルタ回路の特性を個別に設定できると共に安定させることができる。

【００１４】また、請求項４では、請求項１乃至請求項３の何れかに記載の積層デュプレクサ素子において、前記第１フィルタ回路が形成された部分と、前記第２フィルタ回路が形成された部分とを積層方向に重ねて配置してなる積層デュプレクサ素子を提案する。

【００１５】該積層デュプレクサ素子によれば、前記第１フィルタ回路の部分と第２フィルタ回路の部分が積層方向に重ねて配置されるので、実装面積が削減されて高密度実装が可能になる。

【００１６】また、請求項５では、請求項１乃至請求項３の何れかに記載の積層デュプレクサ素子において、前記積層素体は、前記第１フィルタ回路が形成される部分と、前記第２フィルタ回路が形成される部分を層が延びる方向に並べて配置してなる積層デュプレクサ素子を提案する。

【００１７】該積層デュプレクサ素子によれば、前記第１フィルタ回路の部分と第２フィルタ回路の部分が層が延びる方向に並べて配置されるので、積層デュプレクサ素子の高さを低く設定することができ、薄型の電子機器に適用可能になる。

【００１８】また、請求項６では、請求項１乃至請求項３の何れかに記載の積層デュプレクサ素子において、前記積層素体は、前記第１フィルタ回路が形成される部分の一部分が、前記第２フィルタ回路が形成される部分の一部分に積層されてなる積層デュプレクサ素子を提案する。

【００１９】該積層デュプレクサ素子によれば、前記第１フィルタ回路が形成される部分の一部分が前記第２フィルタ回路が形成される部分の一部分のみに重なるように積層されるので、各フィルタ回路間の電気的干渉を抑制し且つ実装面積を削減できる。

【００２０】また、請求項７では、請求項４に記載の積層デュプレクサ素子において、前記共振線路は一端が前記接地端子に接続され他端が開放された帯状導体片からなり、前記第１フィルタ回路の共振線路が、前記第２フィルタ回路の共振線路に対して絶縁体層を介して直角に交差するように配置されている積層デュプレクサ素子を提案する。

【００２１】該積層デュプレクサ素子によれば、前記第１フィルタ回路の共振線路と前記第２フィルタ回路の共振線路が絶縁体層を介して互いに直角に交差するように配置されるので、各フィルタ回路の入出力端子を積層素体の異なる外面に容易に配置することができる。

【００２２】また、請求項８では、請求項４に記載の積層デュプレクサ素子において、前記共振線路は一端が前記接地端子に接続され他端が開放された帯状導体片からなると共に、前記第１フィルタ回路の共振線路の一端が前記第２フィルタ回路の共振線路の他端側に位置し且つ前記第１フィルタ回路の共振線路の他端が前記第２フィルタ回路の共振線路の一端側に位置するように各共振線路が配置され、前記導体片を絶縁体層を介して挟むように設けられた接地導体として、前記第１フィルタ回路の共振線路と前記第２フィルタ回路の共振線路との間に配置され、互いに異なる層に設けられた第１及び第２の接地導体を備え、前記第１接地導体は前記第１フィルタ回路の共振線路の開放端部側の１／２の領域に設けられていると共に前記第２接地導体は前記第２フィルタ回路の共振線路の開放端部側の１／２の領域に設けられており、前記第１フィルタ回路の共振線路と前記第１接地導体との間の距離が、前記第２フィルタ回路の共振線路と前記第１接地導体との間の距離よりも小さく設定されていると共に、前記第２フィルタ回路の共振線路と前記第２接地導体との間の距離が、前記第１フィルタ回路の共振線路と前記第２接地導体との間の距離よりも小さく設定されている積層デュプレクサ素子を提案する。

【００２３】該積層デュプレクサ素子によれば、前記第１接地導体と前記第１フィルタ回路の共振線路の開放端部との間にキャパシタンスが発生し、同一共振周波数において前記キャパシタンスが無いときに比べて前記第１フィルタ回路の共振線路の長さを短くすることができると共に第１フィルタ回路のＱを高めることができる。同様に、前記第２接地導体と前記第２フィルタ回路の共振線路の開放端部との間にキャパシタンスが発生し、同一共振周波数において前記キャパシタンスが無いときに比べて前記第２フィルタ回路の共振線路の長さを短くすることができると共に第２フィルタ回路のＱを高めることができる。さらに、絶縁体層の積層数を削減できるので、積層素体の外形を小型に形成することができる。

【００２４】

【発明の実施の形態】以下、図面に基づいて本発明の一実施形態を説明する。

【００２５】図１は本発明の第１実施形態における積層デュプレクサ素子を示す外観斜視図、図２はその等価回路、図３はその分解斜視図、図４は図３におけるＡ－Ａ線斜視方向の断面図である。本実施形態においては、それぞれ異なる周波数を用いた送信回路と受信回路の双方が１つのアンテナを使用するときに用いる積層デュプレクサ素子の一例を説明する。

【００２６】図において、100は積層デュプレクサ素子で、内部層に共振線路が形成された直方体形状の積層素体110からなり、該積層素体110の外表面には底面111から上面112に延ばして外部端子121～128が形成されている。外部端子121はアンテナに接続される端子である。外部端子122は受信回路に接続される端子、外部端子123は送信回路に接続される端子である。また、その他の外部端子124～128は接地端子である。

【００２７】積層素体110の内部には、図２の等価回路に示すように、受信用のフィルタ回路130と送信用のフィルタ回路140が形成されている。

【００２８】受信用フィルタ回路130は、２．０８～２．２０ＧＨｚの帯域（第１周は数帯域）内の高周波信号を通過させる帯域通過型フィルタで、３つの共振器131～133と、インダクタ134a,134h、キャパシタ134b～134iによって構成されている。

【００２９】受信用フィルタ回路130において、共振器131の一端は接地され、他端はキャパシタ134bの一端に接続されると共にインダクタ134aを介してアンテナ用の外部端子121に接続されている。共振器132の一端は接地され、他端はキャパシタ134d,134eのそれぞれの一端に接続されている。共振器133の一端は接地され、他端はキャパシタ134iの一端に接続されると共にインダクタ134hを介して受信用の外部端子122に接続されている。また、キャパシタ134eの一端はキャパシタ134b,134dの他端に接続され、キャパシタ134eの他端はキャパシタ134f,134gの他端に接続されている。

【００３０】送信用フィルタ回路140は、１．９０～２．０２ＧＨｚの帯域（第２周波数帯域）内の高周波信号を通過させる帯域通過型フィルタで、３つの共振器141～143と、キャパシタ144a～144c、インダクタ144dによって構成されている。

【００３１】送信用フィルタ回路140において、共振器141の一端は接地され、他端はキャパシタ144aを介して送信用の外部端子123に接続されている。共振器142の一端は接地され、他端はキャパシタ144bを介して外部端子123に接続されると共にキャパシタ144cを介してアンテナ用の外部端子121に接続されている。共振器143の一端は接地され、他端はインダクタ144dを介してアンテナ用の外部端子121に接続されている。ここで、共振器141と共振器142との間には相互インダクタンスＭを有し、また共振器142と共振器143との間には相互インダクタンスＭを有している。

【００３２】上記の受信用フィルタ回路130と送信用フィルタ回路140のそれぞれは積層素体110に設けられた導体片及び共振線路から構成される。即ち、図３に示すように、積層素体110は、それぞれ同じ厚さを有する複数の誘電体層（絶縁体層）151～166を積層して構成されており、所定層の誘電体層には表面に共振線路又は導体片或いは接地導体が設けられている。

【００３３】図３において最上層及び第３層目の誘電体層151，153はダミー層であり、第２層目の誘電体層152の表面には接地導体171が設けられている。この接地導体171は接地端子となる外部端子124～128に接続され、外部端子121～123に対応する部分は絶縁のために切り欠かれている。

【００３４】第４層目の誘電体層154の表面の所定位置には後述する共振線路174，175に結合してキャパシタを形成する導体片172が設けられている。

【００３５】第５層目の誘電体層155の表面には所定間隔をあけて互いに平行なストリップ線路からなる３つの共振線路173，174，175が設けられ、それぞれの一端は接地され他端は開放されている。また、共振線路173の一端部所定位置に接続導体176の一端が接続され、接続導体176の他端はアンテナ用の外部端子121に接続されている。また、共振線路175の一端部所定位置に接続導体177の一端が接続され、接続導体177の他端は受信用の外部端子122に接続されている。

【００３６】第６層目の誘電体層156の表面の所定位置には共振線路173，174に結合してキャパシタを形成する導体片178が設けられている。

【００３７】第７層目の誘電体層157はダミー層である。

【００３８】第８層目の誘電体層158の表面には、接地導体179が設けられている。この接地導体179は接地端子となる外部端子124～128に接続され、外部端子121～123に対応する部分は絶縁のために切り欠かれている。

【００３９】第９及び第１０層目の誘電体層159，160はダミー層である。

【００４０】第１１層目の誘電体層161の表面には導体片180が設けられ、導体片180の一端は送信用の外部端子123に接続され、他端は後述する共振線路183の開放端部に結合してキャパシタンスを形成する位置に配置されている。

【００４１】第１２層目の誘電体層162の表面には所定間隔をあけて互いに平行なストリップ線路からなる３つの共振線路181，182，183が設けられ、それぞれの一端は接地され他端は開放されている。また、共振線路181の一端部所定位置に接続導体184の一端が接続され、接続導体184の他端はアンテナ用の外部端子121に接続されている。また、これらの共振線路181，182，183は、上記共振線路173，174，175と平行であり且つ接地端及び開放端が一致するように配置されている。

【００４２】第１３層目の誘電体層163の表面の所定位置には共振線路181，182，183の開放端に結合してキャパシタンスを形成する矩形の導体片185が設けられている。

【００４３】第１４及び第１５層目の誘電体層164，165はダミー層である。

【００４４】第１６層目の誘電体層166の表面には、接地導体186が設けられている。この接地導体186は接地端子となる外部端子124～128に接続され、外部端子121～123に対応する部分は絶縁のために切り欠かれている。

【００４５】前述した積層素体110では、第２層目から第８層目の誘電体層152～158及びこれらの層の表面に設けられた共振線路と接地導体並びに導体片によって受信用のフィルタ回路130が構成され、第８層目から第１６層目の誘電体層158～166及びこれらの層の表面に設けられた共振線路と接地導体並びに導体片によって送信用のフィルタ回路140が構成されている。

【００４６】上記積層デュプレクサ素子100は、受信用フィルタ回路130を構成する共振線路173，174，175及び導体片172，176，177，178が誘電体層152，153，156，157を介して接地導体171，179によって挟まれているため、この接地導体171，179によって受信用フィルタ回路130は外界及び送信用フィルタ回路140から遮蔽され、送信用フィルタ回路140を構成する共振線路181，182，183及び導体片180，184，185が誘電体層158，159，160，163，164，165を介して接地導体179，186によって挟まれているため、この接地導体179，186によって送信用フィルタ回路140は外界及び受信用フィルタ回路130から遮蔽される。これにより各フィルタ回路130，140は、外界及び他方のフィルタ回路の電気的な影響を受けることなく良好な特性を発揮することができる。

【００４７】さらに、受信用フィルタ回路130を構成する共振線路と接地導体並びに導体片のうちの１つ以上が、送信用フィルタ回路140の共振線路と導体片並びに

接地導体が設けられている層とは異なる層に設けられているので、各フィルタ毎に最良の特性を得られるように、各絶縁体層の厚さや共振線路と接地導体との距離を設定することができる。これにより、各フィルタ回路130,140の通過周波数帯域のインピーダンス特性を最適な状態に設定することができる。

【００４８】上記積層デュプレクサ素子100の周波数特性は、図５に示すように、受信用フィルタ回路130と送信用フィルタ回路140のそれぞれにおいて良好な周波数特性を示している。即ち、図５のＲｘの特性曲線に示すように、受信用フィルタ回路130は、受信用周波数帯域において良好な通過特性を示し且つ受信用周波数帯域以外においては大きな減衰を生じさせている。さらに、図５のＴｘの特性曲線に示すように、送信用フィルタ回路140は、送信用周波数帯域において良好な通過特性を示し且つ送信用周波数帯域以外においては大きな減衰を生じさせている。

【００４９】また、上記積層デュプレクサ素子100は、受信用フィルタ回路130の部分と送信用フィルタ回路140の部分が積層素体110の底面111に対して垂直方向に積層されているので、主装置への実装面積が削減されて高密度実装が可能になる。

【００５０】尚、第１実施形態では、受信用フィルタ回路130における共振線路173,174,175を挟む２つの接地導体171,179の間の距離よりも送信用フィルタ回路140における共振線路181,182,183を挟む２つの接地導体179,186の間の距離を大きく設定することにより、各フィルタ回路130,140の通過周波数帯域のインピーダンス特性が良好な状態になるように設定したが、これに限定されることはなく、各フィルタ回路130,140における共振線路や導体片の配置によって任意個別に設定することが好ましい。

【００５１】次に、本発明の第２実施形態を説明する。

【００５２】図６は第２実施形態における積層デュプレクサ素子200を示す外観斜視図、図７はその分解斜視図である。図において、前述した第１実施形態と同一構成部分は同一符号をもって表しその説明を省略する。また、第２実施形態と第１実施形態との相違点は、送信用フィルタ回路140を構成する共振線路181,182,183と、導体片180,185、接続線路184の配置を変えて、共振線路181,182,183が受信用フィルタ回路130の共振線路173,174,175に対して直角に交差するように配置したことである。

【００５３】上記構成によって第１実施形態と同様の効果が得られると共に、アンテナ用の外部端子121と、受信用の外部端子122、送信用の外部端子123のそれぞれを、積層素体110の異なる側面に容易に形成することができるので、これらの外部端子121,122,123の短絡の発生を防止することができると共に、外部端子121,122,123の大きさを第１実施形態と同様の大きさにしながら積層素体110の形状を小型化することができる。

【００５４】次に、本発明の第３実施形態を説明する。

【００５５】図８は第３実施形態における積層デュプレクサ素子300の分解斜視図である。第３実施形態における積層デュプレクサ素子の外観及び等価回路は前述した第１実施形態と同じである。

【００５６】また、第３実施形態と第１実施形態との相違点は、第３実施形態では、図９に示すように、第５層目の誘電体層155の表面に受信用フィルタ回路130の共振線路173,174,175と送信用外部端123との間に送信用外部端子123を囲むように接地導体を311を設けると共に、図１０に示すように、第１２層目の誘電体層162の表面に、送信用フィルタ回路140の共振線路181,182,183と受信用外部端122との間に受信用外部端子122を囲むように接地導体を321を設けたことである。

【００５７】上記構成により、第１実施形態と同様の効果を得られると共に、受信用フィルタ回路130の共振線路173,174,175と送信用外部端子123との間の電気的な結合が接地導体311によって抑制される。また、送信用フィルタ回路140の共振線路181,182,183と受信用外部端子122との間の電気的な結合が接地導体321によって抑制される。これにより、各フィルタ回路130,140の特性を他方のフィルタ回路の影響を受けることなく個別に設定できると共に特性を安定させることができる。

【００５８】尚、図１１に示す積層デュプレクサ素子300Aのように、受信用のフィルタ回路130を構成する他の導体片172,178が設けられている誘電体層154,156の表面にも送信用外部端子123を囲む接地導体312,313を設けても良いし、送信用のフィルタ回路140を構成する他の導体片180,185が設けられている誘電体層161,163の表面にも受信用外部端子122を囲む接地導体322,323を設けても良い。

【００５９】また、受信用外部端子122を囲む接地導体321,322,323のみを設けても良いし、送信用外部端子123を囲む接地導体311,312,313のみを設けても良い。

【００６０】また、上記の受信用外部端子122或いは送信用外部端子123を囲む接地導体は共振線路が形成されている層と同層に設けることが好ましいが、上記接地導体を設ける層は特に規定されることはなく、何れか１つ以上の層に上記外部端子を囲む接地導体を設けることによりほぼ同様の効果を得ることができる。

【００６１】次に、本発明の第４実施形態を説明する。

【００６２】図１２は第４実施形態における積層デュプレクサ素子400を示す分解斜視図、図１３は図１２におけるＡ－Ａ線矢視方向の断面図である。図において、前述した第１実施形態と同一構成部分は同一符号をもって表しその説明を省略する。また、第４実施形態と第１実施形態との相違点は、第４実施形態では、受信用フィルタ回路130の共振線路173,174,175の開放端部と接地導体との間に所定の量のキャパシタンスを形成して共振線路

173,174,175の短縮とフィルタ回路130のQの向上を図ると共に、送信用フィルタ回路140の共振線路181,182,183の開放端部と接地導体との間に所定の量のキャパシタンスを形成して共振線路181,182,183の短縮とフィルタ回路140のQの向上を図ったことである。さらに、共振線路173,174,175と共振線路181,182,183の間の層に配置される接地導体を２つに分割してそれぞれ異なる層に配置することによって、上記キャパシタンスを得られるようにした。

【００６３】即ち、第４実施形態の積層デュプレクサ素子400では、受信用フィルタ回路130の共振線路173,174,175の接地端と開放端の位置が第１実施形態とは反対になるように、受信用フィルタ回路130の共振線路173,174,175と導体片172,178、接続導体176,177を配置した。さらに、第１実施形態における第８及び第９層目の誘電体層158,159を除去した。

【００６４】また、第４実施形態の積層デュプレクサ素子400は、第７層目の誘電体層157の表面に共振線路173,174,175の開放端側に当たるほぼ１／２の領域に接地導体411を設けると共に、接地導体411に接続された複数のビアホール導体412を設けた。さらに、第８層目の誘電体層160の表面に共振線路181,182,183の開放端側に当たるほぼ１／２の領域に接地導体421を設けた。接地導体411と接地導体412は複数のビアホール導体412を介して接続されている。

【００６５】上記構成により、受信用フィルタ回路130の共振線路173,174,175と接地導体411との間の距離Ｌ１が、送信用フィルタ回路140の共振線路181,182,183と接地導体411との間の距離Ｌ２よりも小さく設定される。さらに、送信用フィルタ回路140の共振線路181,182,183と接地導体421との間の距離Ｌ３が、受信用フィルタ回路130の共振線路173,174,175と接地導体421との間の距離Ｌ４よりも小さく設定される。

【００６６】このため、受信用フィルタ回路130の共振線路173,174,175の開放端部と接地導体411との間にキャパシタンスが発生するので、共振線路173,174,175の長さを短縮することができると共に受信用フィルタ回路130のQを高めることができる。また、送信用フィルタ回路140の共振線路181,182,183の開放端部と接地導体421との間にキャパシタンスが発生するので、共振線路181,182,183の長さを短縮することができると共に送信用フィルタ回路140のQを高めることができる。

【００６７】さらに、接地導体411,421のそれぞれは誘電体層157,160の互いに異なる側の１／２の領域に設けられ、それぞれが重なり合う部分においてビアホール導体412を介して接続されているので、これら２つの接地導体411,421によって受信用フィルタ回路130と送信用フィルタ回路140との間の電気的な遮蔽を行うことができる。

【００６８】また、受信用フィルタ回路１３０の共振線路173,174,175及び送信用フィルタ回路140の共振線路181,182,183の長さの短縮と誘電体層の削減により、積層デュプレクサ素子400の小型化を図ることができる。

【００６９】また、第４実施形態においても第１実施形態と同様の効果を得られることは言うまでもない。

【００７０】次に、本発明の第５実施形態を説明する。

【００７１】図１４は第５実施形態における積層デュプレクサ素子500を示す外観斜視図、図１５は図１４におけるＡ－Ａ線矢視方向の断面図、図１６はその分解斜視図である。本実施形態においては、第１実施形態と同じ等価回路並びに周波数特性を有する積層デュプレクサ素子であり、且つ受信用フィルタ回路130を構成部分と送信用フィルタ回路140を構成部分が並べて形成されている積層デュプレクサ素子の一例を説明する。

【００７２】図において、500は積層デュプレクサ素子で、内部層に共振線路が形成された直方体形状の積層素体510からなり、該積層素体510の外表面には底面511から上面512に延ばして外部端子521～528が形成されている。外部端子521はアンテナに接続される端子である。外部端子522は受信回路に接続される端子、外部端子523は送信回路に接続される端子である。また、その他の外部端子524～528は接地端子である。

【００７３】積層素体510の内部には、前述した図２の等価回路に示す受信用のフィルタ回路130と送信用のフィルタ回路140が形成されている。

【００７４】上記の受信用フィルタ回路130と送信用フィルタ回路140のそれぞれは積層素体510に設けられた導体片及び共振線路から構成される。即ち、図１６に示すように、積層素体510は、それぞれ同じ厚さと長方形の平面を有する複数の誘電体層（絶縁体層）551～560を積層して構成されており、所定層の誘電体層には表面に共振線路又は導体片或いは接地導体が設けられている。

【００７５】図１６において最上層の誘電体層551はダミー層であり、第２層目の誘電体層552の表面にはその長辺方向一端側の１／２の領域に接地導体571が設けられている。この接地導体571は接地端子となる外部端子524,525,528に接続され、アンテナ用及び送信用の外部端子521,523に対応する部分は絶縁のために切り欠かれている。

【００７６】第３層目の誘電体層553はダミー層である。

【００７７】第４層目の誘電体層554の表面にはその長辺方向他端側の１／２の領域に接地導体572が設けられている。この接地導体572は接地端子となる外部端子526,527,528に接続され、アンテナ用及び受信用の外部端子521,522に対応する部分は絶縁のために切り欠かれている。

【００７８】第５層目の誘電体層555の表面には導体片573が設けられ、導体片573の一端は送信用の外部端子523に接続され、他端は後述する共振線路577の開放端部に

結合してキャパシタンスを形成する位置に配置されている。

【００７９】第６層目の誘電体層556の表面には、長辺方向の他端側１／２の領域内の所定位置に後述する共振線路581,582に結合してキャパシタを形成する導体片574が設けられている。さらに、第６層目の誘電体層556の表面には、長辺方向の一端側１／２の領域内に所定間隔をあけて互いに平行なストリップ線路からなる３つの共振線路575,576,578が設けられ、それぞれの一端は接地され他端は開放されている。また、共振線路575の一端部所定位置に接続導体579の一端が接続され、接続導体579の他端はアンテナ用の外部端子521に接続されている。また、これらの共振線路575,576,578は、誘電体層556の短辺に平行になるように配置されている。

【００８０】第７層目の誘電体層557の表面には、長辺方向の他端側１／２の領域内の所定位置に所定間隔をあけて互いに平行なストリップ線路からなる３つの共振線路580,581,582が設けられ、これらの共振線路580,581,582のそれぞれの一端は接地され他端は開放されている。また、共振線路580の一端部所定位置に接続導体583の一端が接続され、接続導体583の他端はアンテナ用の外部端子521に接続されている。また、共振線路582の一端部所定位置に接続導体584の一端が接続され、接続導体584の他端は受信用の外部端子522に接続されている。

【００８１】さらに、第７層目の誘電体層557の表面には、長辺方向の一端側１／２の領域内の所定位置には共振線路575,576,578の開放端に結合してキャパシタンスを形成する矩形の導体片585が設けられている。

【００８２】第８層目の誘電体層558の表面には長辺方向の他端側１／２の領域内の所定位置に共振線路580,581に結合してキャパシタを形成する導体片586が設けられている。

【００８３】第９層目の誘電体層559はダミー層である。

【００８４】第１０層目の誘電体層560の表面には、ほぼ全域に亘って接地導体587が設けられている。この接地導体587は接地端子となる外部端子524～528に接続され、外部端子521～523に対応する部分は絶縁のために切り欠かれている。

【００８５】前述した積層素体510では、長辺方向の他端側１／２の領域に設けられた共振線路と接地導体並びに導体片によって受信用のフィルタ回路130が構成され、長辺方向の一端側１／２の領域に設けられた共振線路と接地導体並びに導体片によって送信用のフィルタ回路140が構成されている。

【００８６】また、受信用フィルタ回路130における共振線路580,581,582を挟む２つの接地導体572,587間の距離Ｌ５と送信用フィルタ回路140における共振線路575,576,577を挟む２つの接地導体571,787間の距離Ｌ６とが異なる値に設定されている。さらに、受信用フィルタ回路130を構成する共振線路と接地導体並びに導体片のうちの１つ以上が、送信用フィルタ回路140の共振線路と導体片並びに接地導体が設けられている層とは異なる層に設けられている。これにより、受信用及び送信用フィルタ回路130,140のそれぞれにおいて、通過周波数帯域のインピーダンス特性を最適な状態に設定することができる。

【００８７】また、受信用フィルタ回路130を構成する共振線路580,581,582及び導体片574,583,584,586が誘電体層554,555,558,559を介して接地導体572,587によって挟まれているため、この接地導体582,587によって受信用フィルタ回路130は外界及び送信用フィルタ回路140から遮蔽され、送信用フィルタ回路140を構成する共振線路575,576,577及び導体片573,579585が誘電体層552,553,554,557,558,559を介して接地導体571,587によって挟まれているため、この接地導体571,587によって送信用フィルタ回路140は外界及び受信用フィルタ回路130から遮蔽される。これにより各フィルタ回路130,140は外界及び他方のフィルタ回路の電気的な影響を受けることなく良好な特性を発揮することができる。

【００８８】また、第５実施形態の積層デュプレクサ素子500は、受信用フィルタ回路130の部分と送信用フィルタ回路140の部分が積層素体510の底面511上に並べて配置されるので、積層デュプレクサ素子500の高さを低く設定することができ、薄型の電子機器に適用可能になる。

【００８９】尚、上記第５実施形態では、受信用フィルタ回路130における共振線路580,581,582を挟む２つの接地導体572,587の間の距離よりも送信用フィルタ回路140における共振線路575,576,576を挟む２つの接地導体571,587の間の距離を大きく設定することにより、各フィルタ回路130,140の通過周波数帯域のインピーダンス特性が良好な状態になるように設定したが、これに限定されることはなく、各フィルタ回路130,140における共振線路や導体片の配置によって任意個別に設定することが好ましい。

【００９０】また、上記第５実施形態では、受信用フィルタ回路130を構成する部分すなわち接地導体572,587に挟まれる部分を積層素体510の底面511の側に設けたが、図１７及び図１８に示す第６実施形態の積層デュプレクサ素子500Aのように受信用フィルタ回路130を構成する部分を積層素体510の上面512側に設けても良いし、図１９及び図２０に示す第７実施形態の積層デュプレクサ素子500Bのように受信用フィルタ回路130を構成する部分を積層素体510の底面511と上面512の中間位置に設けても良い。

【００９１】また、図２１及び図２２に示す第８実施形態のように、第５実施形態の積層素体510において受信用フィルタ回路130を構成する部分の上面512側のダミー層となる部分を除去した階段形状の積層素体510Cを備え

た積層デュプレクサ素子500Cを構成しても良い。

【００９２】また、図２３に示す第９実施形態のように、第５実施形態の積層デュプレクサ素子500における受信用フィルタ回路130を構成する部分と送信用フィルタ回路140を構成する部分を別の層に形成し、且つ受信用フィルタ回路130を構成する部分の一部と送信用フィルタ回路140を構成する部分の一部が重なるように配置した積層デュプレクサ素子500Dを構成しても良い。このように受信用フィルタ回路130を構成する部分の一部と送信用フィルタ回路140を構成する部分の一部が重なるように配置しても、各フィルタ回路間の電気的干渉を抑制できると共に主装置への実装面積を低減することができる。

【００９３】尚、上記各実施形態の構成は本願発明の一具体例であって、本願発明がこれらの構成のみに限定されることはなく、各実施形態の構成を組み合わせても良いことは言うまでもない。

【００９４】

【発明の効果】以上説明したように本発明の請求項１乃至請求項８に記載の積層デュプレクサ素子によれば、接地導体によって第１フィルタ回路及び第２フィルタ回路のそれぞれが互いに遮蔽されると共に外界から遮蔽されるので、双方のフィルタ回路において最良の特性を得ることができる。さらに、第１フィルタ回路の導体片及び接地導体のうちの１つ以上が、第２フィルタ回路の導体片及び接地導体が設けられている層とは異なる層に設けることにより、各絶縁体層の厚さや共振線路と接地導体との距離を各フィルタ回路毎に設定することができるので、各フィルタ毎に最良の特性を得ることができる。

【００９５】また、請求項２に記載の積層デュプレクサ素子によれば、上記の効果に加えて、第１フィルタ回路と第２フィルタ回路のそれぞれにおいて、共振線路を挟む２つの接地導体間の距離を異なる値に設定することにより、各フィルタ回路の通過周波数帯域のインピーダンス特性が最良の状態に設定される。

【００９６】また、請求項３に記載の積層デュプレクサ素子によれば、上記の効果に加えて、入出力端子を囲むように接地導体を設けたため、第２フィルタ回路の共振線路と第１入出力端子との間の電気的な結合、或いは第１フィルタ回路の共振線路と第２入出力端子との間の電気的な結合が抑制されるので、各フィルタ回路の特性を個別に設定できると共に安定させることができる。

【００９７】また、請求項４に記載の積層デュプレクサ素子によれば、上記の効果に加えて、第１フィルタ回路の部分と第２フィルタ回路の部分が積層素体の積層方向に重ねて配置されるので、主装置への実装面積が削減されて高密度実装が可能になる。

【００９８】また、請求項５に記載の積層デュプレクサ素子によれば、上記の効果に加えて、第１フィルタ回路の部分と第２フィルタ回路の部分が積層素体の層が延びる方向に並べて配置されるので、積層デュプレクサ素子の高さを低く設定することができ、薄型の電子機器に適用可能になる。

【００９９】また、請求項６に記載の積層デュプレクサ素子によれば、上記の効果に加えて、第１フィルタ回路が形成される部分の一部分が第２フィルタ回路が形成される部分の一部分のみに重なるように積層されるので、各フィルタ回路間の電気的干渉を抑制し且つ実装面積を削減することができる。

【０１００】また、請求項７に記載の積層デュプレクサ素子によれば、上記の効果に加えて、第１フィルタ回路の共振線路と第２フィルタ回路の共振線路が互いに直角に交差するように配置されるので、各フィルタ回路の入出力端子を積層素体の異なる外面に容易に配置することができる。

【０１０１】また、請求項８に記載の積層デュプレクサ素子によれば、上記の効果に加えて、共振線路の長さを短くすることができると共に絶縁体層の積層数を削減できるので、積層素体の外形を小型に形成することができる。さらに、各フィルタ回路のＱを高めることができる。

【図面の簡単な説明】

【図１】本発明の第１実施形態における積層デュプレクサ素子を示す外観斜視図

【図２】本発明の第１実施形態における積層デュプレクサ素子の等価回路を示す図

【図３】本発明の第１実施形態における積層デュプレクサ素子を示す分解斜視図

【図４】図３におけるＡ－Ａ線斜視方向の断面図

【図５】本発明の第１実施形態における積層デュプレクサ素子の周波数特性を示す図

【図６】本発明の第２実施形態における積層デュプレクサ素子を示す外観斜視図

【図７】本発明の第２実施形態における積層デュプレクサ素子を示す分解斜視図

【図８】本発明の第３実施形態における積層デュプレクサ素子を示す分解斜視図

【図９】本発明の第３実施形態における要部を示す平面図

【図１０】本発明の第３実施形態における要部を示す平面図

【図１１】本発明の第３実施形態の積層デュプレクサ素子の他の構成例を示す分解斜視図

【図１２】本発明の第４実施形態における積層デュプレクサ素子を示す分解斜視図

【図１３】図１２におけるＡ－Ａ線矢視方向の断面図

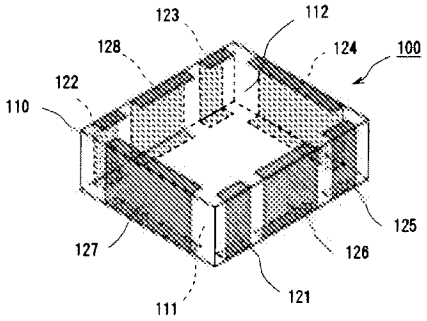
【図１４】本発明の第５実施形態における積層デュプレクサ素子を示す外観斜視図

【図１５】図１４におけるＡ－Ａ線矢視方向の断面図

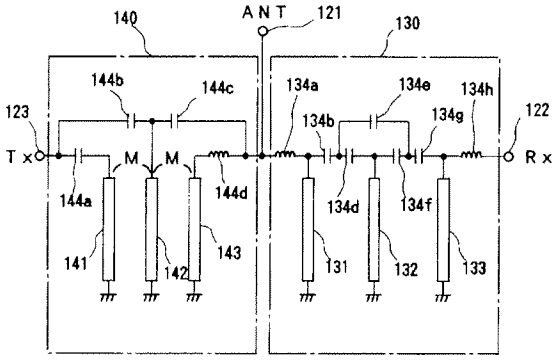
【図１６】本発明の第５実施形態における積層デュプレ

クサ素子を示す分解斜視図
【図１７】本発明の第６実施形態における積層デュプレクサ素子を示す分解斜視図
【図１８】図１７におけるＡ－Ａ線矢視方向の断面図
【図１９】本発明の第７実施形態における積層デュプレクサ素子を示す分解斜視図
【図２０】図２０におけるＡ－Ａ線矢視方向の断面図
【図２１】本発明の第８実施形態における積層デュプレクサ素子を示す分解斜視図
【図２２】図２２におけるＡ－Ａ線矢視方向の断面図
【図２３】本発明の第９実施形態における積層デュプレクサ素子を示す側断面図
【符号の説明】
100, 200, 300, 300A, 400, 500, 500A～500D…積層デュプレクサ素子、110, 210, 510…積層素体、111, 211, 511…底面、112, 212, 512…上面、121, 521…アンテナ用外部端子、122, 522…受信用外部端子、123, 523…送信用外部端子、124～128, 524～528…接地用外部端子、130…受信用フィルタ回路、131, 132, 133…共振器、134a, 134h…インダクタ、134b, 134d, 134e, 134f, 134g…キャパシタ、140…送信用フィルタ回路、144a, 144b, 144c…キャパシタ、144d…インダクタ、151～166…誘電体層（絶縁体層）、171, 179, 186…接地導体、172, 178, 180, 185…導体片、173, 174, 175, 181, 182, 183…共振線路、175, 176, 184…接続導体、311, 312, 313, 321, 322, 323…接地導体、411, 421…接地導体、412…ビアホール導体、551～560…誘電体層（絶縁体層）、571, 572, 587, 588, 589, 591, 592, 593…接地導体、573, 574, 585, 586…導体片、575, 576, 577, 580, 581, 582…共振線路、579, 583, 584…接続導体。

【図１】




【図２】

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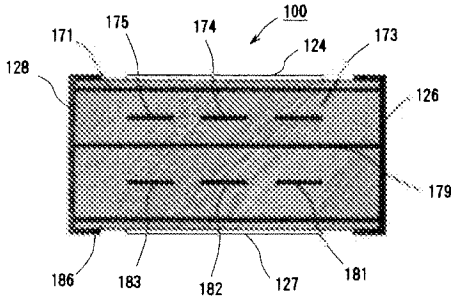


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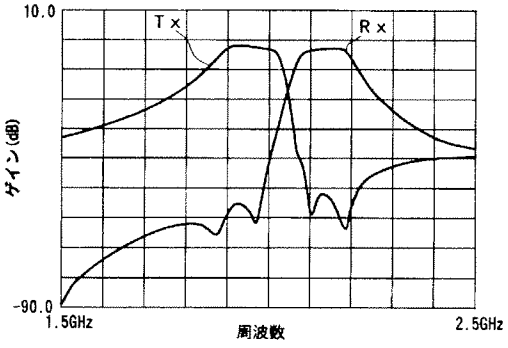
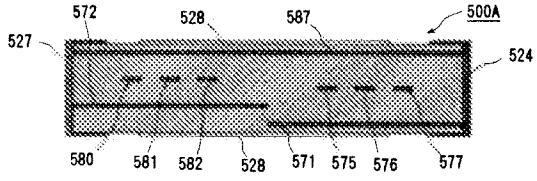



【図１８】



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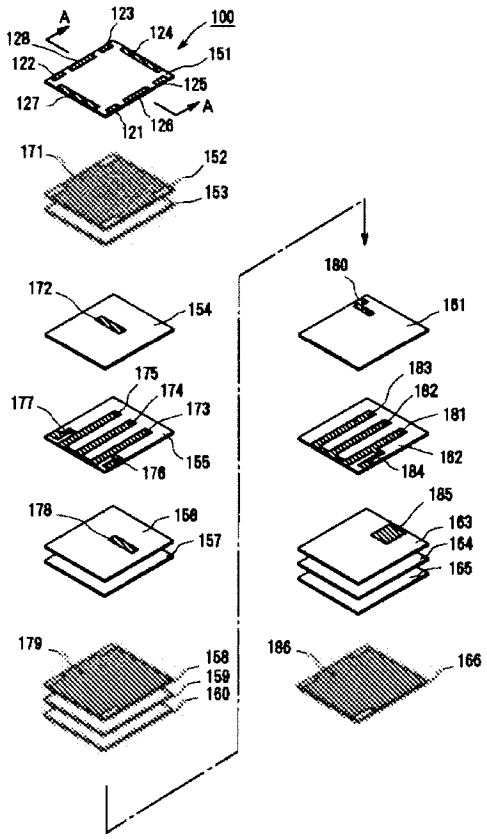


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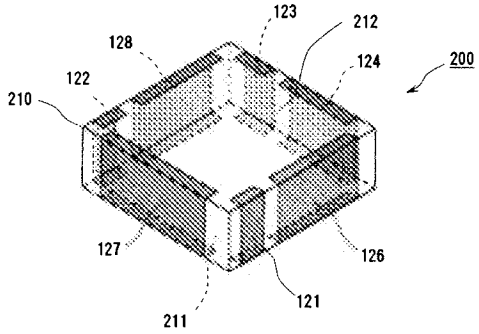


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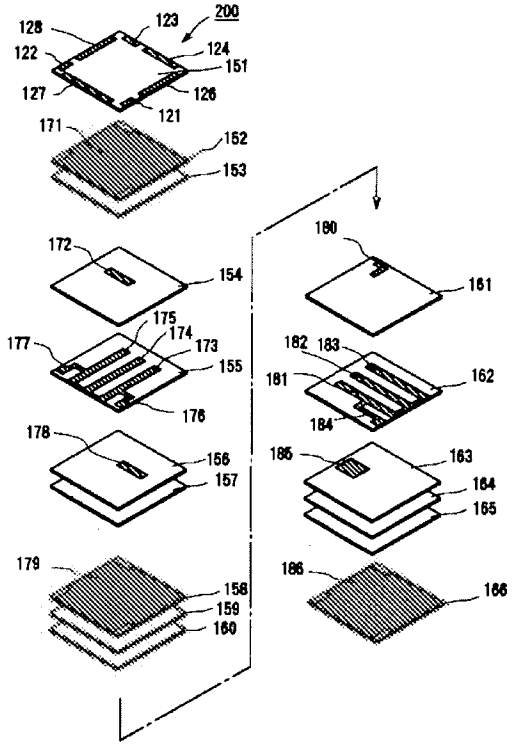


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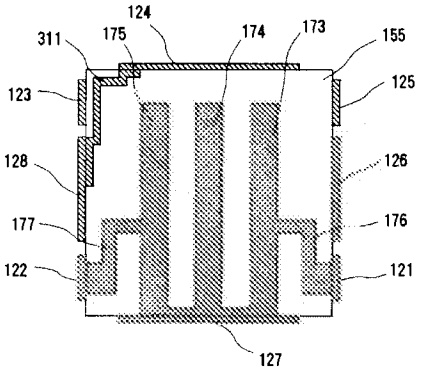
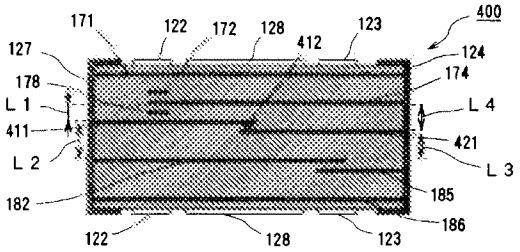



【図１３】



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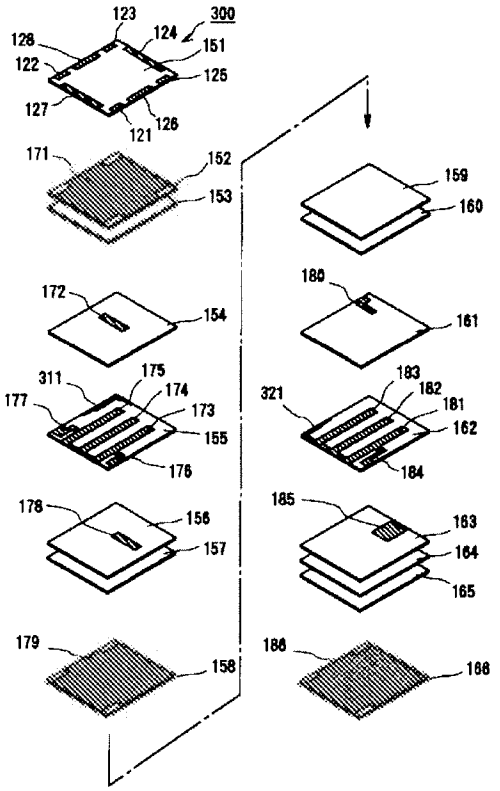
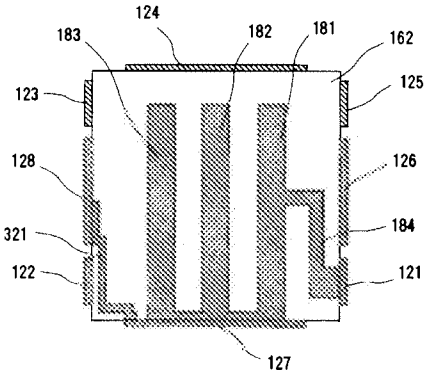
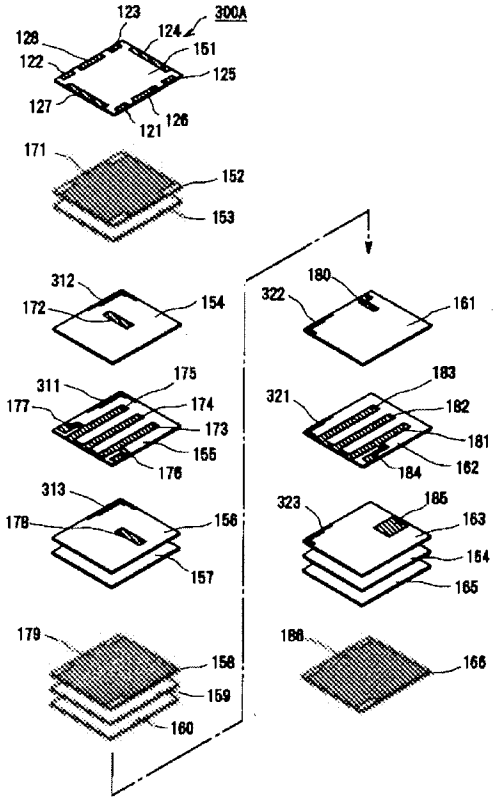



【図１０】




【図１１】

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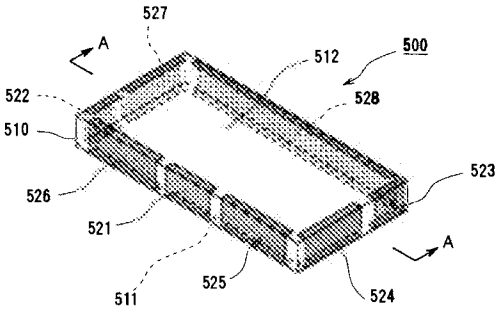


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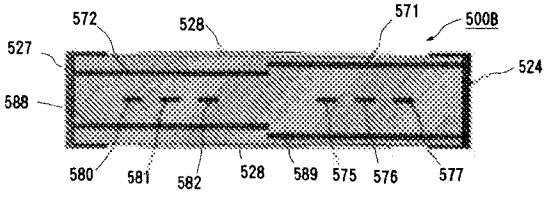

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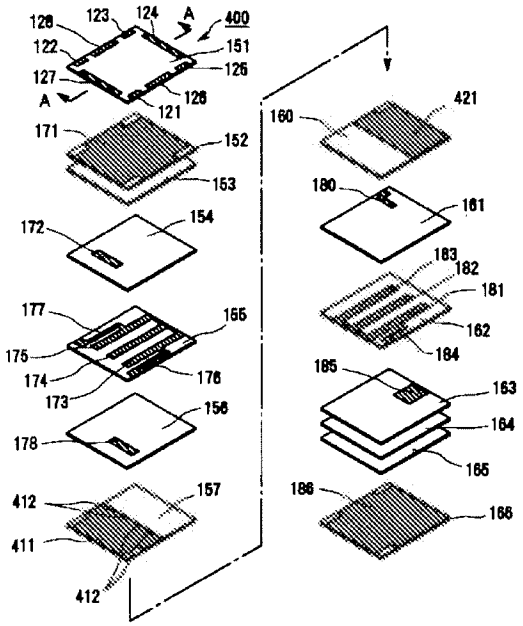


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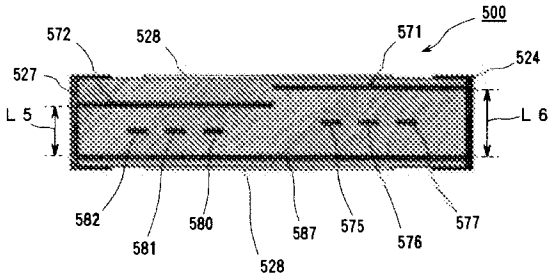


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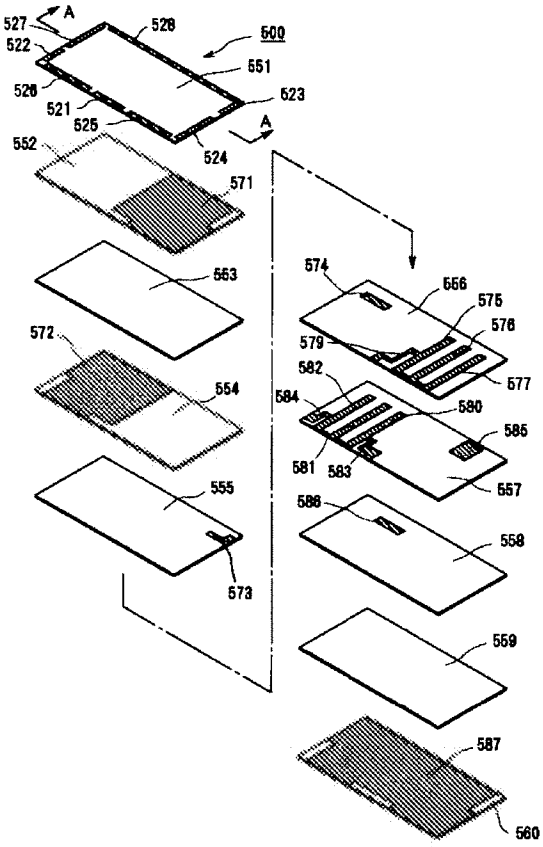
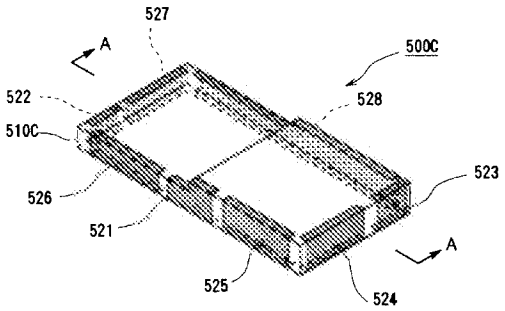



【図２１】

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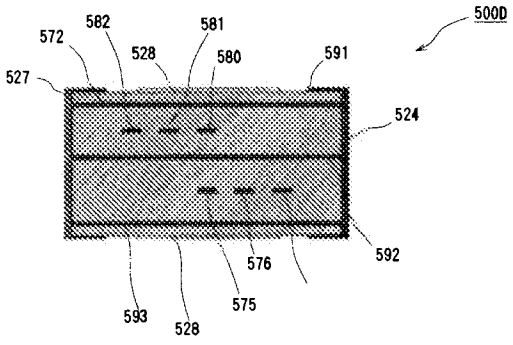

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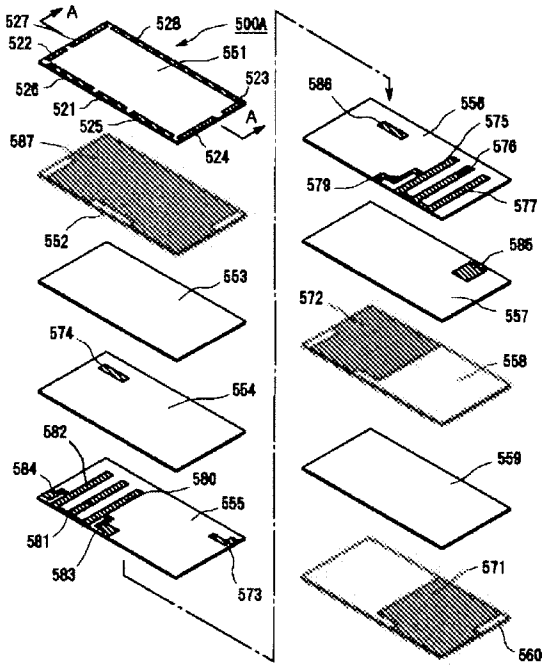
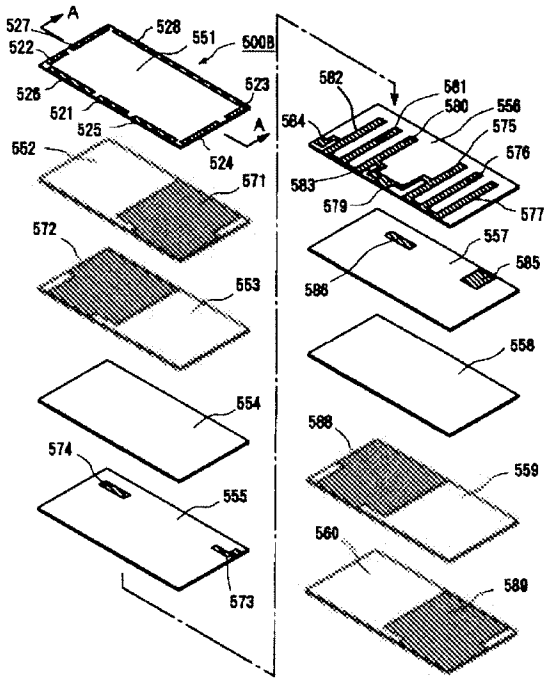
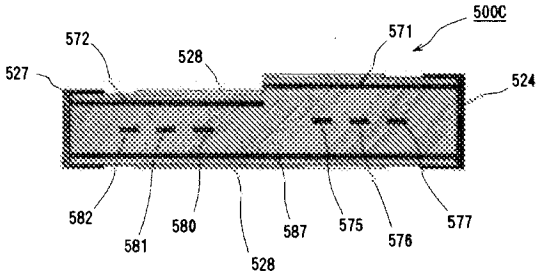



【図１９】




【図２２】

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| 7/46 | | H01F 15/00 | D | |

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